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Range

RESEARCH HI-LITES

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

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☆ MAY 26 1949 ☆
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Volume I, Number 1

May 20, 1949

This is the first issue of a monthly news letter formulated by the Division of Range Research and designed to help keep you informed of developments in range management and reseeding research. More complete information, in formal publications, will be available periodically for the asking.

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Reseeding After Logging: Seeding skid roads, trails, and landings, following logging, to perennial grasses is an effective means of stabilizing soil, preventing accelerated run-off, and increasing forage production, according to Research Note No. 49 recently issued by the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. Seeding should be done as soon after logging as practicable and mixtures of three or four perennial grass species are favored. Smooth bromegrass, tall oatgrass, crested wheatgrass, and chewings fescue have all given good success in the yellow pine zone in eastern Oregon. With proper stocking and other good range management practices protection of the seeded areas is not necessary to insure good stands of these forage species. In all the trials conducted to date, reseeding of forage species after logging has not interfered with satisfactory natural regeneration of yellow pine and other forest species on the reseeded areas. Similar results have been obtained in tests on the Bitterroot National Forest by the Northern Rocky Mountain Station.

Helicopter Best for Seeding Mustard: Since 1932 the Forest Service has been sowing common mustard seed on burned mountain watersheds in California to quickly restore the protective vegetative cover and thus prevent or reduce destructive floods. Hand methods proved to be too slow and costly - as much as $3.00 per acre. Seeding from airplanes was tried - at half the cost - but hazards were high, seed distribution poor, and the planes could not fly low enough in rough country to insure successful seeding. Recent tests on the Angeles National Forest indicate that the helicopter is the answer. A strip 60 feet wide was seeded at an average ground concentration of 20 seeds per square foot while the helicopter traveled at a speed of 30 miles per hour and about 50 feet above the ground. The cost was about two cents an acre more than the cost of seeding mustard by conventional airplanes. In these tests the helicopter operated successfully over a 5,400-foot peak with a pay load of 280 pounds of seed. -- Forest Service Washington Office News Release.

Sagebrush Burning: In the fall of 1947 a sagebrush burning study was started on the Whitworth Brothers' ranch, 30 miles west of Dell, Montana, to determine the effects of burning on range vegetation and to test the applicability of methods developed by the Intermountain Forest and Range Experiment Station at Dubois, Idaho. Prior to burning in early September, after the perennial grasses had scattered their seed and the sagebrush was just beginning to bloom, approximately 20 percent of the soil surface was occupied by vegetation. Half was sagebrush, the rest mostly grasses and weeds of minor importance. Only about one-third of the forage plants were available to the sheep. The burn was 90 percent successful, but small islands of sagebrush remained where the stand was thin. One year after burning, 1948, the grass cover was only 50 percent as dense as before burning. This is one of the many dangers in using fire to remove sagebrush. One-half of the total plant cover after burning was weeds of low grazing value. The forage species were fully available. First-year sagebrush seedlings, established after burning, were 20 to 30 times taller, had extensive root systems, and were considerably more vigorous on burned than on nearby unburned range. Surface litter was almost completely destroyed. Had the area been reseeded after burning, competition would have prevented or at least limited reinvasion by the sagebrush. This study indicates that burning sagebrush in southwestern Montana is inadvisable unless followed immediately by reseeding. The ultimate outcome of this test depends largely on the ability of the remaining grass plants to gain control of the area before the sagebrush seedlings develop into another dense stand. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Calves Grow Faster With Proper Stocking: Range calves on moderately and lightly stocked northern Great Plains range near Miles City grew faster from birth through weaning than those on range stocked heavily. This test conducted cooperatively by the Forest Service, the Bureau of Animal Industry, and the Montana Agricultural Experiment Station provided 38.8 acres per cow and calf yearlong under the light rate of stocking, 30.5 acres under moderate, and 23.1 acres under the heavy rate. Under all three stocking rates, calf birth weights were approximately equal. But from soon after birth until weaning time the difference in weight between the heavily stocked and moderately and lightly stocked calves progressively increased. Over an 8-year period of fair to above normal years, this difference at weaning time amounted to about 33 pounds. Both heifer and steer calves were similarly affected. Fewer calves also were weaned during this period under the heavy rate of stocking. This jumped the advantage of the lighter stocking rates, in average weaning weight of calf per cow, to approximately 55 pounds per year. Even though all groups of calves were treated alike for a year after weaning those from heavily stocked range were unable to overcome the setback suffered during the suckling period. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Soil Deterioration Caused By Heavy Range Use: Fence line comparisons on eastern Montana ranges experimentally stocked with cattle at heavy and light rates for 14 years showed degradation of soil resulting from heavy range use. Surface litter, and organic matter content and porosity of the surface two-inches of soil were less for each of several vegetation and soil subtypes within the heavily stocked range pastures. Under heavy stocking infiltration of .92 inches of water into range soils took 1-1/2 to 2-1/2 times as long as under light stocking. Penetration depth per inch of gentle rain into the soil ranged from 92 to 80 percent as great on the heavily stocked areas. Heavy clay soils showed greater differences than sandy loams. With rains of heavier intensity more run-off and greater loss of water would be expected. -- Northern Rocky Mountain Forest and Range Experiment Station release.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

lume I, Number 2 June 20, 1949

Effects of Certain Animals On the Soil: More frequently than not, vegetational effects on soil development are stressed to a greater degree than the influence of animal populations in soils. Animals living in the soil range from minute protozoa to burrowing mammals of fairly large size. It is estimated that the microbial population of cultivated soil weighs approximately 18,000 pounds per acre in the topmost 8 inches. Earthworms are very active in converting raw vegetable matter to humus and in mixing the humus with the mineral portion of the soil. In soils of medium to clayey textures, earthworms are estimated to modify in structure and organic content 500 to 2,500 tons of soil per acre per year. In addition to mixing mineral matter with humus, they carry organic matter into the subsoil horizons as they go downward during dry weather. Also they leave tunnels behind them thus aiding movement of water through the soils. Ants are among the most important of the insect population of the soils. Leaf-cutting ants carry fragments of plant leaves and stems for long distances and store them underground. In this manner, organic matter is incorporated in the soil and converted to humus through the activities of fungi (planted by ants). The red ant which builds a conical mound above the soil surface is more familiar to the westerner. The material used in the mounds is fine earth mixed with coarse sand and fine gravel brought up from subsoil horizons thus rejuvenating the soil. It is estimated that ants in desert soils of southwestern Utah pile as much as 3,400 pounds per acre of such material on the earth's surface. They carry balls of earth from beneath and deposit them at the surface in chimney-like formations. Important to soil rejuvenation are the burrowing mammals most common in the Great Plains and deserts. Prairie dogs, gophers, and other rodents burrow well into the substrata beneath the soil bringing parts of all horizons to the surface. On Rago soils of Colorado, it was conservatively estimated that burrowing animals bring 30-40 tons per acre of mixed sand, gravel, and subsoil to the surface annually. Calculations of gopher activity at Lincoln, Nebraska, showed that 28 tons per acre had been piled up by these animals in a few weeks. Many other burrowing animals contribute to the organic content of the soils. Quoting the author ". . . . the animals that live in the soil in many places are almost as important in the development of soil profiles as the vegetation of the region". -- James Thorp, University of Nebraska, Scientific Monthly, Volume LXVIII, No. 3, March 1949.

Fertilizer Increases Herbage Production On Reseeded Range Land: In April 1948, ammonium sulphate (20 percent nitrogen) was drilled on 4-year-old crested wheatgrass plots near Florence, Montana. Rates of 120, 192, and 320 pounds per acre were used.

Air-dry herbage clipped from the plots in July averaged 2,535, 3,257, and 3,180 pounds per acre, respectively. Without fertilizer herbage production was only 1,760 pounds per acre. Thus, extra herbage was produced and at a cost of about $12, $10, and $16 per ton; a nominal cost for highly nutritious, green herbage. Rainfall was better than average in the summer of 1948, but during a short dry spell some fertilizer burn was noted on the plots that received 320 pounds of fertilizer. This shows that the heavy rate is too high for best results during average seasons. Further tests are needed to determine the most efficient rate. In March 1949 the residual effect of the fertilizer was very obvious, especially on the plots that received the heaviest application. There was several times more new spring growth on the fertilized than on the unfertilized plots. Any increases in herbage production over the unfertilized yields in 1949, will, of course, reduce the cost per ton figures given above and might even alter the relationship between the rates of application. Early application, so that the fertilizer is available during the period of maximum plant growth, is an important key to successful use of fertilizers. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Hard Fescue - A Rugged Range Grass: Hard fescue, Festuca ovina variety Duriuscula, is proving to be very widely adapted for seeding in Montana. This is the grass that has been called sheep fescue strain P-2517. It has been grown experimentally by the Northern Rocky Mountain Forest and Range Experiment Station since the spring of 1940 and is now thriving on sandy cut-over land at Thompson Falls, elevation about 2,500 feet and on dry abandoned farmland in the Bitterroot valley and Judith Basin. It is also doing well on skid trails on the Bitterroot National Forest; in competition with Kentucky bluegrass and quackgrass in the Rattlesnake valley and at the Vigilante Station; and at 9,350 feet on the Beaverhead National Forest. Hard fescue is outstanding in its ability to produce stands on poorly prepared seedbeds, if not covered too deeply, 3/4 inches or less, and in its ability to compete with cheatgrass and weeds. It is even crowding crested wheatgrass severely in mixtures on dry land in the Bitterroot valley. It is one of the earliest grasses to start in spring and ripens seed some three weeks earlier than crested wheatgrass. Grazing value of hard fescue has not been determined but there is strong evidence that its palatability is low compared to many common forage species, except perhaps very early in the season. Leaves are long and wiry and persist for 2 or 3 years thus providing a very effective soil cover. It offers real promise for seeding where soil protection is more important than forage production and also on concentration areas because it withstands trampling well. Even on heavily grazed areas relatively low palatability may help it to persist. Hard fescue was selected and standardized by the Soil Conservation Service at Pullman, Washington, and has been certified and released for seed production in that State. It is available commercially in limited amounts. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Weeping Lovegrass (Eragrostis curvula) Survives Region One Winter: Weeping lovegrass (Eragrostis curvula) is a well known perennial forage grass in the southern Great Plains. Range adaptation trials with this species in Region One, outside its natural range, have generally been unsuccessful because of its inability to withstand severe winter conditions. A range planting of weeping lovegrass made in 1948 at the Republic Ranger Station in Ferry County, Washington, came through the past winter with flying colors. This is the first known instance of winter survival of weeping lovegrass in Region One. In other trials weeping lovegrass has produced luxuriant leaf growth during the year seeded but has always winter killed. Sand lovegrass (Eragrostis trichodes) planted under the same conditions in Ferry County did not survive the winter. -- Northern Rocky Mountain Forest and Range Experiment Station release.

eder over hand broadcasting methods are (1) more uniform distribution, especially on very rough or broken areas, (2) the 35-pound capacity bag is conveniently rigged for carrying with a shoulder strap, and (3) light applications can be accurately gauged and applied. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Pelletizing Reduces Seed Viability: Laboratory and field tests recently conducted by the Pacific Northwest Forest and Range Experiment Station and reported in Research Note #53 have revealed some of the effects of pelletizing on the viability of grass seed. Material for the tests consisted of crested wheatgrass pellets and loose seed from a pellet reseeding project conducted in 1947 near Gooding, Idaho.

The loose or untreated seed had a purity of 75.3 percent and viability was 73 percent. Using whole pellets only 5 seeds per pellet germinated. From seed material carefully washed out of pellet samples pellet germination was calculated as 25 percent. Compared with 73 percent for unpelleted seed this means that 66 percent of the viable seed used in compounding the pellets failed to germinate.

In the field, pellets were broadcast by hand at 43 pounds per acre (an equivalent of 2 pounds of seed) on both cultivated and uncultivated seedbeds. Loose seed was both broadcast and drilled on similar seedbeds. Numbers of seedlings resulting on cultivated seedbeds averaged 1.0 per 10 square feet from pellets, 3.25 per 10 square feet from loose seed broadcast, and 10.25 per 10 square feet from drilled loose seed. On uncultivated seedbeds seedling numbers average 0.5, 0.7, and 8.5, respectively, per 10 square feet. Differences in seedling counts between cultivated and uncultivated seedbeds were not significant for any method of seeding but as the season advanced the cultivated seedbed showed an advantage.

These tests showed definitely that loose seed produced better grass stands than pellets and that drilling, using an equivalent amount of seed, was better than broadcasting. -- Pacific Northwest Forest and Range Experiment Station Research Note #53, April 25, 1949.

Grass Seed High Priced: Recent information from the Soil Conservation Service indicates that good quality grass seed is likely to command a high price this fall. One North Dakota producer is listing Russian wildrye at 80 cents per pound, intermediate wheatgrass at 85 cents, and green needlegrass at 80 cents per pound. Standard crested wheatgrass is 50 cents. All prices are f.o.b. origin. -- Clipped.

New Facts Concerning Mesquite: The spread of mesquite, a noxious range plant throughout the Southwest, is facilitated by Merriam kangaroo rats and unstable, coarse textured soils, both common on Southwestern ranges in poor condition. From sheep feeding trials it was found that digestion processes destroyed 69 percent of the mesquite seeds eaten. Thirty-one percent were eliminated as whole seeds capable of germination. -- From a digest of progress on R.M.A. projects. This research was conducted by the Southwestern Forest and Range Experiment Station.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 5 September 20, 1949

Airplane Pellet Seeding: The results of seeding 90,000 acres of deteriorated range land on four Indian reservations in the Southwest by the airplane pellet method have finally come to light. In a discussion of the method and results obtained on range lands in Arizona and New Mexico, Joe A. Wagner, Ranger Supervisor, Papago Indian Agency, Sells, Arizona, explodes many of the fantastic claims heard for the method when it was originated several years ago.

The seedings were made between April 1946 and August 1948 on the Papago, San Carlos, Hopi, and Navajo Indian Reservations. Several range and forest vegetation types at various elevations were included in the trials. All seedings are now considered failures.

The number of seed per pellet varied from 2 to 59; sweetclover averaged 10, and timothy 28. Viability tests on crested wheatgrass showed that pelleting decreased germination percent from 81 to 15. Smooth, small, and hard seeds were not appreciably injured.

Airplane loads varied from 800 to 1,600 pounds and each load contained from 2 to 32 pounds of seed.

The rodent repellent, dry lime-sulphur, was not effective. Rats gathered up the pellets containing the repellent and ate the seed with apparent relish.

Penetration of pelleted seed into soil was practically nil. Penetration was evident on very loose gopher mounds and plowed furrows but the pellets were clearly visible being merely embedded in the loose soil.

On 10,000 acres of Papago range land 75 plants per acre of Lehmann lovegrass became established on the average from a seeding of 175,000 to 250,000 seeds per acre.

On the San Carlos reservation pellets were both sown by airplane and drilled into a prepared seed bed. Unpelleted seed was also drilled. A year later the stand was extremely poor and spotty on the drilled areas. Not a single plant of the reseeded species could be found on the area sown by airplane.

Concerning the Hopi and Navajo seedings the author states, "Generally, no evidence of establishment can be found on open ground....". -- "Results of Airplane Pellet Seeding On Indian Reservations", Joe A. Wagner, Journal of Forestry, Vol. 47, No. 8, August 1949.

ment On Airplane Seeding: Airplane pellet seeding should not be confused with the broadcasting of loose or unpelleted seed from airplanes.

The idea of pelleting grass seed was originated by Dr. Lytle S. Adams, a retired dentist. He also originated the pelleting process and invented equipment for distribution of the pellets from aircraft. The pelleting was, of course, intended to provide the covering known to be necessary for seed germination and establishment of new plants. The article reviewed above covers some of the first and most extensive seeding operations conducted by this method. The results are disappointing not only because of the loss entailed but because they are contrary to expectations and to early claims which were made for the method.

On the other hand broadcasting of loose seed from airplanes under certain conditions has given good success in a number of instances in Montana and Utah. Stands have resulted on freshly burned timber and mountain brush areas having a sufficient bed of ashes to cover the seed and aspen or other deciduous tree or brush areas where falling leaves provided the necessary covering for the seed. Very loose soils in a region of high rainfall have been reseeded successfully by airplane broadcasting of loose seed. Large acreages of burned brushland in California have also been successfully seeded to mustard by airplane broadcasting. Success might also be attained by using a species such as bulbous bluegrass which does not require covering. Under these conditions airplane seeding is a practicable method of rapidly seeding otherwise inaccessible areas at a very low cost. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Ranch Day: The ninth annual Ranch Day of the New Mexico College Ranch and Jornada Experimental Range has been announced by Director Price for Monday, October 10. The annual Ranch Days are presented jointly by the New Mexico College of Agriculture and Mechanical Arts and the Southwestern Forest and Range Experiment Station, Tucson, Arizona.

This year considerable time will be devoted to the problem of noxious plants on range lands and research and action programs leading to their effective control. Also of interest will be the consideration of feeding salt and cottonseed meal in mixture as range supplements. As is customary in alternate years, the major portion of the program this year will be held on the College Ranch.

The motor caravan will assemble at the Dona Ana courthouse in Las Cruces at 7:30 a.m., and will proceed to the College Ranch. A chuck wagon lunch will be served at noon. -- Southwestern Forest and Range Experiment Station release.

The Bitterroot Has Goatweed Too: Ranchers in the upper Bitterroot valley are becoming alarmed by the rapid spread of goatweed (Hypericum perforatum) on range and pasture lands. The original infestation, according to Bitterroot forest personnel and local residents, occurred 6 or 7 years ago after sheep were trailed from Idaho to the vicinity. It is estimated that about a thousand acres on the west side of the valley mid-way between Hamilton and Darby are now infested with this noxious weed.

Plans are going forward for cooperative research on the control of goatweed in this area. Interested individuals and agencies include the Ravalli County Agricultural and Weed Control offices, the Bitterroot National Forest, and the Northern Rocky Mountain Forest and Range Experiment Station, as well as local ranchers and farmers. -- Northern Rocky Mountain Forest and Range Experiment Station release.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 6 October 20, 1949

Alfalfa increases soil nitrogen: A subject frequently discussed by range men concerns the effects, if any, of legumes on soil nitrogen. Some contend that legumes grown in mixture with grasses contribute significant amounts of nitrogen to the soil. Others insist that the legumes must be plowed under as green manure to increase the amount of nitrogen in the soil. Research conducted on dry land in the Cache and Juab Valleys of northern and central Utah has provided some insight to the subject. This study, summarized in the following paragraphs, was initiated to measure changes in nitrogen content of soil planted to alfalfa for varying numbers of years following wheat. Actually the nitrogen content of soils under alfalfa and wheat and on unplowed, virgin land was studied.

In the Cache Valley area, alfalfa varied in age from 2 to 30 years. Fields which had been in alfalfa 10 to 13 years showed as much recovery of nitrogen in the first foot of soil as those that had been in alfalfa 15 to 30 years. Recovery of nitrogen on farms in these two age groups each averaged 62.5 percent. For the 2- to 5-year age group, recovery amounted to 35.5 percent. The average loss of nitrogen from growing wheat (comparing virgin with wheat land) was 20.3 percent. In the second foot of soil, the average loss for the 20 farms studied was also 20.3 percent and the recovery of this loss of nitrogen by growing alfalfa averaged 41.7 percent. In the third foot a loss of 14.5 percent occurred and the recovery by growing alfalfa amounted to 9.1 percent but was not significant.

Accounting for the nitrogen in the hay, adding this to that accumulated in the soil, and dividing by the years of cropping gave the average yearly increase of nitrogen per acre of 246 pounds. For the 20 farms studied in Cache Valley, the amount ranged from 76 to 672 pounds.

In the Juab Valley, the nitrogen content of the first foot of virgin soil of the two farms sampled was 0.131 and 0.148 percent, respectively. Since alfalfa grown on these farms maintained the soil nitrogen at or near these respective amounts, it might be considered that this is near the equilibrium level. In Cache Valley, where some of the virgin lands contained less nitrogen than those in Juab Valley, the maximum recovery by growing alfalfa amounted to 88.2 percent of that lost. The nitrogen equilibrium level for land in alfalfa following wheat is considered to be approximately 7 percent below adjacent virgin areas. -- A. F. Bracken and L. H. Larson, Utah Agri. Experiment Station 1947. "Increases in Nitrogen from Growing Alfalfa on Dry Land". Soil Science 64: July-December 1947, pp. 37-45.

Time of Herbage Removal Effects Plant Response: Good range management is aimed not only at the proper intensity of use, but also at the proper time of use. James P. Blaisdell and Joseph F. Pechanec of the Intermountain and Pacific Northwest Forest and Range Experiment Stations have recently reported a clipping study done at Dubois, Idaho, between 1942 and 1947. This study throws further light on the effect of herbage removal at various times during the growing season. Plants studied were bluebunch wheatgrass and arrowleaf balsam root. The authors found that injury due to a single ground level clipping increased as the growing season progressed up until about June 6 for wheatgrass and May 28 for balsam root. At these dates wheatgrass heads were just showing while balsam root was in full bloom. Reaction was similar, however, whether fruiting stalks were common or not. After these dates injury gradually decreased until at maturity it was very low. Herbage yield and flower stalk production in the year following clipping were more sensitive indicators of injury than average heights. -- Ecology, Vol. 30, pages 298-305, 1949.

Rice Hulls Aid Grass Seed Planting: A helpful aid in drilling small, light, fluffy or hairy surfaced grass seed has been discovered by O. K. Hoglund, agronomist at the Soil Conservation Service nursery at Pleasanton, California. Hoglund mixes the seed with rice hulls, opens the drill wide, and plants.

Farmers have long had difficulty in calibrating grain drills to sow the right amount of seed of numerous forage species and of seed mixtures. Small and relatively heavy seeds usually run out of the drill spouts first, leaving the lighter, fluffier seeds behind. This results in spotty, uneven seedings.

Having used bran, sawdust, cracked barley, and sand unsuccessfully as carriers of seed mixtures, Hoglund tried rice hulls. Seeds not trapped in the cups of the hulls seemed to "float" in the spaces between them. In a grain drill set for seeding barley at the rate of 160 pounds per acre the mixture of seed and rice hulls came through in almost precise proportion to the desired rates of the seed mixture. Even in a mechanical seed cleaner, only about 50 percent of the seeds were separated from the possessive rice hulls. Results of field plantings lend support to Hoglund's discovery.

To mix the the hulls and seeds, simply spread the rice hulls on a tarpaulin or clean floor, weigh out the proper quantities of the various seeds and scatter them evenly over the hulls. Mix with a shovel. Set the grain drill for 160 pounds of barley per acre, fill the drill box with the mixture of seed and rice hulls and you are ready to go. -- Washington Farmer, April 7, 1949.

Depth Regulators for Drills: Inability to closely regulate depth of planting for grass and legume seed has been one of the most common causes of failure in range reseeding trials. Most grasses and legumes must be seeded at a shallow depth on a firm seedbed to obtain good stands.

The Nursery Division of Soil Conservation Service has released information on a depth regulator which has been used for several years. It is easy to construct and can be attached to any drill having straight disks for furrow openers. A piece of strap iron 1-1/2 to 1-5/8 inches wide is made into a circular band 2 inches smaller in diameter than the disks on the drill. To this band are attached 3 pieces of strap iron, each about 5 inches long and bent to form a right angle. Holes for 3/8 or 1/2 inch carriage bolts are bored in the disk. The result is a band fastened at a desired distance from the edge of the disk which will limit penetration of the disk and therefore the depth at which the seed is planted. The band also tends to pack the soil.

Only one band per furrow opener is used and drag chains are not necessary. Use of the depth regulator does not eliminate the need for good seedbed preparation. The depth regulator insures uniform stands from seedings of single species or mixtures and reduces excessive seedling competition among the components of a mixture. -- From material for planner's handbook by A. L. Hafenrichter, Regional Nursery Division, Soil Conservation Service.

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MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 7 November 20, 1949

Influence of Grazing and Mulch On Forage Growth: Past investigations have indicated the need of conservative range use and the consequent return of plant litter to the soil for the maintenance of range health.

A study was initiated on the Roosevelt National Forest in Colorado to investigate the effects of protection and organic mulch on forage production. The study was established in a closely grazed, small Kentucky bluegrass (Poa pratensis) park in the ponderosa pine type at 8,300 feet elevation. Clipped vegetation of two concentrations (full and half) was used as mulch, simulating the amounts of vegetation which would accumulate annually on an ungrazed range and on a range utilized about 50 percent.

Moderately used range produced an average of twice as much forage as one used heavily. Protected range produced almost three times as much forage as an adjacent heavily grazed range. The study also indicated that 55 to 91 percent of the annual forage growth occurred before June 1 on grazed ranges. Decreasing the grazing intensity resulted in an increase in summer forage production.

Light and heavy mulch applications to heavily grazed range increased annual forage production 42 percent and 50 percent, respectively, the first year. Full-mulch produced somewhat less summer forage growth than half-mulch. It was concluded that organic mulch in the amount accumulating on moderately or ungrazed ranges may be the most important factor influencing summer forage production. Even during severe drought years, a heavy mulch is considered most effective in stimulating range recovery because of the greater total annual growth produced. -- Journal of Range Management, Volume 2, July 1949, Number 3, pp. 142-148.

Results of Sagebrush Burning Confirmed: Reexamination of a 2-year-old big sagebrush (Artemisia tridentata) burn tends to confirm tentative conclusions made last year. Crown area of 2-year-old big sagebrush plants has increased 55 percent on the burned area in the past year. A weight comparison of 2-year-old sagebrush plants showed that plants from the burned area were about 255 times as heavy as those from an adjacent unburned area. Survival of the well-established plants on the burned area is certain. Current seedlings of big sagebrush were somewhat more abundant on the control than on the burned area. This is probably because old plants on the control area were unharmed and continued to produce seed. Survival of these seedlings in competition with the other vegetation is doubtful.

Grasses increased in density during the 1949 season on those areas that were burned two years ago. Idaho fescue, Sandberg bluegrass, Junegrass, plains reedgrass, and thickspike wheatgrass all showed exceptional vigor this year. At least 90 percent of these grass plants produced fruiting stalks compared with about 5 percent on a nearby unburned area and none on a one-year-old burn. This condition is attributed to recovery of the surviving plants from the effects of the fire and to increased availability of soil moisture and nutrients because of the reduced total vegetal cover. Despite the increased vigor shown this year, grasses are still below the preburning density of 1947.

Weeds on the burned area continued to increase, whereas on the unburned area, they have shown a gradual decline. Present density (1949) of weeds is approximately 350 percent greater than the preburning densit of 1947 and about 30 percent more than the 1948 density (one year after burning).

These results emphasize that: (1) prescribed burning of big sagebrush ranges destroys the old sagebrush plants; (2) desirable grasses are reduced in density by burning; (3) an influx of weeds usually occurs; (4) availability of existing herbage is increased temporarily; and (5) sagebrush seedlings and surviving grasses develop vigorously through reduction of competition from other vegetation. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Range Research in South Africa: "Plants are living organisms, the well-being of which must be cared for to the same extent as that of the grazing animals which feed on them," says Dr. H. Weinmann, pasture research chemist in Southern Rhodesia. He amply supports his contention with facts showing that vigorous plant growth and high herbage production from a pasture is to a large extent dependent upon the amount of carbohydrates stored in plant roots. This, in turn, is closely connected with degree of herbage removal.

Clipping and grazing trials were conducted near Johannesburg, where the climate is comparable to parts of southern Texas.

Herbage yields, root weights, and carbohydrates in the roots all decreased when plants were clipped more than twice each season (September to May). When clipped 16 times a season forage production dropped from 1,520 pounds the first year to 225 pounds the following year. Although percentage of crude protein, phosphorous, and potassium increased with clipping, total yields went down due to the overcompensating reduction in dry matter production.

Fertilization increased yields, but failed to prevent reduction due to overclipping. Similarly, while fertilization almost doubled yields in moderately grazed pastures it increased the herbage by only one-fourth in a heavily grazed pasture. Root weights and storage of carbohydrates were favored by fertilization only where grazing was moderate. These tests showed that lack of adequate carbohydrate storage rather than mineral elements was limiting growth under the heavy rates of utilization. -- "Some Fundamental Aspects of Moderan Pasture Management", by H. Weinmann, Southern Rhodesia Department of Agriculture and Lands, Bulletin 1367.

Range Research Seminar Scheduled: Range research and management personnel of the Forest Service are scheduled to meet in Ogden, Utah, from November 28 through December 3 to consider the range research program. Designed as a series of round-table discussions the meeting will provide opportunities to review the program country-wide as well as for individual experiment stations. This is the first meeting of its kind since 1944. -- Northern Rocky Mountain Forest and Range Experiment Station release.

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Chas. L. Tebbe - Director

Volume I, Number 8 December 20, 1949

Production of Seed and Forage By Mountain Brome As Influenced By Nitrogen and Age of Stand: A study was made by the Idaho Agricultural Experiment Station to determine the influence of varying levels of nitrogen availability on seed and forage production of Bromar mountain brome. The same field was used for 3 successive years to determine the effect of age of stand and the interaction between age and nitrogen on seed production. Irrigated land was used to eliminate precipitation differences.

All rates of nitrogen application gave profitable returns in yield of seed - 20 pounds per acre of nitrogen required to give a significant difference in yield and no indication that the upper limit in yield had been reached with the application of 103 pounds per acre.

To produce significant differences in yield of forage of mountain brome, more than 30 pounds of nitrogen per acre was required. The results also indicated that applications of nitrogen increased forage production more than seed yield.

Both seed and forage production were influenced by seasonal conditions and age of stand. Forage production was affected by adverse climatic conditions more than seed yield while age of stand had the greatest effect on seed production. -- Agronomy Journal, Vol. 41, No. 11, November 1949.

Bluestem - King Ranch Strain: A species of bluestem (Andropogon Ischaemum), native to India, was found in 1939 on the King Ranch at Kingsville, Texas. In its native habitat the species grows from high altitudes to sea level, in rainfall zones from 8-10 to 100 inches, and on many soils. The King Ranch strain has been grown in the Southwest from the Gulf Coast to northern Oklahoma. It is a drought-resistant, deep-rooted perennial grass that forms tufts and tends to spread eliminating all competition. It has been used successfully in the reclamation of abandoned cropland, cutover brush land, weedy range land, and eroded areas.

Seed-producing habits of this species differ from those of other grasses in that seed is produced during the late spring-early summer period and again in the fall. The seed germinates readily without covering and has been used successfully in reseeding areas where seedbed preparation is impossible.

Trials with this strain have shown that it is more drought resistant, palatable, competitive, and grows more vigorously than other strains of bluestem. Also, it has

successfully survived temperatures as low as 20 degrees below zero in Oklahoma. It will grow equally well on acid or alkaline soils. -- The Cattleman, Vol. XXXVI, No. 7, December 1949.

Competition Between Sagebrush Seedlings and Reseeded Grasses: Competition between sagebrush seedlings (big and threetip sagebrush) and reseeded grasses was studied by James P. Blaisdell of the Intermountain Forest and Range Experiment Station, on abandoned farmland in Idaho which had become occupied by sagebrush. Grasses were planted two years before sagebrush, one year before sagebrush, concurrently with sagebrush, one year after sagebrush, two years after sagebrush, and three years after sagebrush. All vegetation was removed from the study plots before planting grass or sagebrush. Plot ratings, plant counts, and weight estimates of herbage measured the relative success of the sagebrush and grass seedlings.

Grass herbage yields were much larger than sagebrush yields on plots sown to grasses prior to or as late as one year after sagebrush. On those plots seeded to grass two or three years after sagebrush, yields of sagebrush were larger. Generally, high grass yields were associated with low sagebrush yields. Established plant suppression accounted for yield differences rather than failure of plants to become established. Concurrent establishment of grasses and sagebrush gave an initial advantage to grasses but, as the sagebrush became larger, competition with grasses resulted in a reduced grass density and yield on many plots.

It was concluded that: (1) the effect of sagebrush competition on reseeded grasses depends upon the relative ages of the sagebrush and grass stands; (2) young sagebrush seedling stands may allow satisfactory establishment of grass stands, but suppress the grass resulting in a yield reduction; (3) two-year-old or older sagebrush plants are not greatly affected by grass subsequently established; (4) establishment of grass stands before sagebrush, suppresses sagebrush seedlings or entirely prevents sagebrush establishment indefinitely; (5) because of earlier maturity, grasses established at the same time as sagebrush have an initial advantage and suppress sagebrush seedlings; and (6) maximum opportunity to gain over sagebrush seedlings is given to grasses when reseeded during the same year that sagebrush is removed. -- Ecology, Vol. 30, No. 4, October 1949.

Salt Consumption By Cattle In Southwestern Montana: A preliminary analysis of salting records from the Vigilante Experimental Range, stocked with cows and calves from June 1 to October 31 annually, indicates that the consumption rate increased from June through August then decreased thereafter. The average amount of salt used per cow per month on this high mountain range during the 1948 and 1949 grazing seasons was: June 1.07 pounds, July 1.70 pounds, August 2.70 pounds, September 1.98 pounds, and October 1.53 pounds. These data refute the old concept that range cattle require more salt when the forage is lush than later when it is nearing maturity. A similar trend in salt consumption has been established for cows and calves on short-grass ranges near Miles City, Montana. This rising trend appears to be closely controlled by the decreasing mineral content of range forage, which is known to be highest in spring and early summer when growth is rapid. As growth slows down and range herbage dries, mineral content decreases and larger amounts of salt are required by cattle to make up the deficiency. Fall growth of herbage following late summer rains provides green forage which reduces the amount of salt needed by grazing animals. -- Northern Rocky Mountain Forest and Range Experiment Station release.

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Range RESEARCH HI-LITES

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 10 February 20, 1950

Sheep Eat Minerals Because They Like Them: Is the appetite of an animal a reliable guide to its needs? Many would say, yes. I. J. Cunningham, superintendent, Department of Agriculture Animal Research Station, Wallaceville, New Zealand, says, no. He tells of a mineral feeding test of sheep to support his conclusion.

Two groups of sheep under similar conditions were selected for the experiment. Individuals of one group were given one-third ounce of the mineral in a pint of water daily through a stomach tube. The other was dosed with water only. Each group had free access to all the minerals they wanted. Over a four-month period, sheep dosed with minerals ate on the average 20 percent more of the freely available minerals than those which received only the water dosage. This is contrary to what one would expect if sheep eat the minerals because they need them. Cunningham concludes that the animals take the minerals because they like them, and not because they need them. -- New Zealand Journal of Agriculture, Vol. 79, No. 6, p. 583, 1949.

Run-off and Erosion Increased With Grazing Intensity: Knowledge of the effect of grazing intensity upon run-off and soil erosion is of vital importance in grazing management, especially on mountain watersheds. E. G. Dunford, at the Rocky Mountain Forest and Range Experiment Station, has recently reported results from studies on this problem in Colorado. The studies were made on six 1/100-acre plots on a Arizona fescue-mountain muhly range with a 17 percent slope at the Manitou Experimental Forest. Cattle were allowed to remove an average of 57 and 33 percent of the herbage on duplicated plots for heavy and moderate grazing. In addition, two plots were completely protected.

Measurements between 1942-48 showed that run-off was two and three times greater on moderately and heavily grazed plots, respectively, than on the ungrazed control plots. Soil erosiion was not significantly effected by moderate grazing, but almost doubled by heavy grazing, being 186 pounds per acre compared to less than 100 for the control. These data, though restricted in scope, indicate too heavy grazing not only lowers the absorption of moisture needed for plant growth by the soil, but by increasing soil erosion strikes at the productive potential and watershed value of the site. -- Relation of Grazing to Run-off and Erosion On Bunchgrass Ranges, Rocky Mountain Forest and Range Experiment Station Research Note No. 7, 1949.

Grazing Use Indicates Severity of 1949 Drought: Drought, like the proverbial bad penny, always returns. After 11 favorable seasons, the longest period of good years on record at Miles City, drought returned last year to the northern Great Plains. The season was similar to 1936 with its sparse rainfall, short grass crop, and hordes of grasshoppers.

Many criteria, built mostly on weather records have been used to tell the inexperienced what drought is. Anyone who has lived in the northern Great Plains or in a similar semiarid region has his own standard - usually his pocketbook. Because important relationships of range vegetation to weather are not precisely known and needed related data are often lacking, weather records are difficult to interpret. Distribution of rainfall throughout the growing season may actually be more important than the total amount of rainfall received. Likewise, the effectiveness of current rainfall is tied in with the precipitation of the previous fall and winter and depends upon temperature and other prevailing factors. The need for other measures of drought becomes readily apparent.

Since 1932 a set of experimental native range pastures, at the United States Range Livestock Experiment Station near Miles City, has been stocked with cattle each year. The intended grazing season extended from May 15 to November 15 annually. Drought and other factors intervened and shortened the grazing season in 2 or 3 years during the 17-year period. However, a careful record of grazing use covering the entire period is now available as a basis for the comparison of any year with the others. Although 3 pairs of pastures representing 3 rates of range stocking were included in the set-up the record for any pair will suffice for comparisons since all were subject to the same length of grazing season.

In 1933, the first full grazing season for the experimental pastures and the last favorable one before the great drought, 4,360 animal unit days or 145 animal unit months of grazing were taken from one pair of pastures. Rainfall at Miles City during the first seven months of 1933 totalled 6.4 inches, about 70 percent of the long-time average.

The following year, 1934, the same pair of pastures provided only 1,850 animal unit days or 62 animal unit months of grazing. Rainfall for the first seven months of 1934 was only 3.3 inches, 36 percent of the long-time average.

During 1936, the second severe drought year during the thirties, the precipitation for seven months was 3.7 inches and the pastures provided even less grazing than in 1934. Only 1,410 animal unit days or 47.0 animal unit months were obtained before August 7 when all cattle were removed from the pastures.

From 1938 through 1945 grazing use in the pastures averaged 4,048 animal unit days or 135 animal unit months annually. Last year, 1949, 5.2 inches of precipitation fell at Miles City during the first seven months and the pastures provided 1,382 animal unit days or 46 animal unit months of grazing use. Again, as in 1936, all cattle were removed from the pastures in August to prevent losses.

Thus we find that the pastures in 1949 were less productive, in terms of grazing use, than in either 1934 or 1936. Precipitation for the first seven months, although 1.5 and 1.9 inches, respectively, above the 1934 and 1936 levels, was only 57 percent of the long-time average. Based on grazing use records then, and considering only the area occupied by the experimental pastures, 1949 was a more severe drought year than either 1934 or 1936. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Quality of Crested Wheatgrass Decreases With Maturity: Between May and September the nutritive value of crested wheatgrass decreases rapidly according to findings reported by Jerry Sotola. Crude protein, expressed as a percent of total dry matter, dropped from 20.59 to 3.22 percent. Its digestibility also decreased. The percentage of phosphorous decreased steadily. Crude fiber and nitrogen-free extract, on the other hand, tended to increase. This indicates the need for intensive management of this grass for maximum animal production. -- "The Chemical Composition and Apparent Digestibility of Nutrients in Crested Wheatgrass Harvested in Three Stages of Maturity", Journal of Agricultural Research, Vol. 61, No. 4, August 15, 1940, pp.303-311.

Agriculture-Missoula

Range
RESEARCH HI-LITES

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 9 January 20, 1950

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A New Method of Determining Consumption and Digestibility of Forages By Ruminants: J. T. Ried et al of Cornell University announced at the recent American Society of Animal Production meeting in Chicago a new and indirect method of determining the amount and digestibility of forages consumed by cattle and sheep. Existing methods of estimating forage consumption, other than by weighed feedings, are both inexact and laborious because they require subjective ocular estimation of volume-weight removed and clipping to simulate grazing. Similarly, estimates of forage digestibility, while precise, in the main require elaborate digestion trials including quantitative chemical analysis of forage samples before feeding, collection of total dung, and consequent measurement of undigested fractions by further chemical means. The limitations of these methods have long retarded the accumulation of such information pertinent to range and pasture management and animal nutrition.

The method developed by the Cornell group permits an indirect measurement of forage intake and its digestibility based on the presence in forages of chromogenic substances which pass through the animal totally undigested. Chromogens are substances which, as by contact with air, readily become coloring matter. The method involves spectrophotometric determination of the chromogenic content of forage and corresponding dung and calculation of digestibility coefficients and intake of forage. Results obtained compared to those derived by conventional digestion trials demonstrated the validity of the procedure. Should the method prove adapted to studying mixed range forages, it would be a considerable boon to the management field. -- Extracted from "Abstracts of Papers to be Presented At the 41st Annual Meeting At the American Society of Animal Production," Journal Animal Science 8(4): 636, November 1949.

Northern Great Plains Section of Range Management Society Formed: Forty-seven members of the American Society of Range Management met in Miles City, Montana, on November 22, 1949, to form a northern Great Plains section of the parent society. Necessary petitions were signed, and a constitution adopted, subject to the approval of the national council. One of the objectives of the section is a more complete understanding of northern Great Plains land management problems, through bringing together and fostering discussion by ranchers, administrators, technicians, researchers, and others who are interested in this vast grazing province. Temporary officers are Dan Fulton (rancher), president; Bruce Orcutt (rancher), vice-president; and Tom Dudley (Bureau of Land Management), secretary-treasurer, all from eastern Montana. Council members include J. A. Campbell, Dominion Department of Agriculture, Canada; Henry Holzman, Extension Service, South Dakota; Steve F. Hlebichuk, Production and Marketing Administration, North Dakota; Floyd Larson, Bureau of Land Management, central Montana; and Leon C.

Hurtt, Forest Service, western Montana. Membership in the section is open to members of the Society in good standing, and who have an interest in the northern Great Plains. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Range Utilization By Elk: A recent examination of utilization data from a big game winter range in Montana has shown some interesting points concerning range use by elk. During the severe winter of 1948-49 elk removed 61 percent of the grass herbage, and 50 percent of the nongrass herbage from plots located on heavily stocked range. Total herbage removal averaged 57 percent. From plots on moderately stocked range 41 and 45 percent, respectively of the grass and nongrass herbage was removed and total removal of herbage averaged 42 percent. Although the intensity of sampling was the same on ranges stocked at different intensities, it was limited in each case. This may explain the contrasting utilization of grass and nongrass herbage between the differently used areas.

In terms of allowable use for most grass species this degree of utilization is just about one hundred percent too high. Most of the perennial forage grasses cannot withstand removal of more than about 20 to 30 percent of their herbage each year over a long period. Although allowable use has not been defined for most nongrass species, it seems probable that it would average considerably lower than the use observed in this case. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Gopher Appetites and Activities: From 17 years of study in eastern Oregon a manuscript, proposed for publication as a USDA circular, has been prepared on the Dalles pocket gopher and its influence on mountain meadows.

The Dalles gopher feeds mainly on surface vegetation and on roots and underground stems. They prefer broadleaved herbs but will eat grasses and even young pines and quaking aspens. Average daily herbage consumption was found to be 71 grams per gopher. At this rate 16 gophers, the average population per acre, would utilize about 900 pounds of vegetation annually.

Studies of changes in mountain meadow vegetation in relation to gopher populations showed that a heavy gopher population on a meadow in poor condition prevented the meadow from improving in condition. Removal of gophers from such a meadow allowed it to improve. When pocket gophers were removed from a meadow in poor condition, grazing capacity increased from 1.24 sheep months per acre to 7.41 sheep months per acre in 8 years even though sheep grazing continued. Where sheep were excluded grazing capacity increased from 0.59 sheep months per acre to 6.56 sheep months per acre. When pocket gophers were introduced into a grazed meadow in fair condition, no reduction in grazing capacity or in range condition of the meadow resulted in 8 years. Pocket gopher control may be necessary for range improvement on gopher-infested mountain meadows in poor condition but on mountain meadows in fair range condition control may not be needed to increase forage production. -- Abstract, "The Dalles Pocket Gopher and Its Influence On Forage Production of Mountain Meadows." A. W. Moore and E. H. Reid.

A Comparison of Cheatgrass and Reseeded Grasses in Southwestern Idaho: Studies were made in southwestern Idaho by the Intermountain Forest and Range Experiment Station to determine growth periods and amounts of herbage produced by cheatgrass and reseeded species. Results of these investigations reported by A. C. Hull, Jr., indicated that the only merit of cheatgrass was that in some years considerable herbage was produced without the labor of reseeding. This characteristic alone would not provide a stable basis for a livestock operation.

In these tests crested wheatgrass produced more herbage, began spring growth earlier, remained green longer, and fluctuated less in production from year to year. Other reseeded species studied showed one or more of these desirable features. By seeding these early and late growing grasses the green forage period can be extended considerably on range lands formerly occupied by cheatgrass. -- Journal of Range Management, Vol. 2, No. 4, October 1949.

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Range RESEARCH HI-LITES

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 11

March 20, 1950

Salt-Meal Mixture Saves Labor: The feeding of protein concentrates on the range in winter as supplements to range forage has been a common practice for many years. The practice has gained favor with both cattle and sheep growers particularly in the Great Plains and Southwest where yearlong grazing is feasible. Considerable labor is involved in feeding protein concentrates on the range because only one day's allowance can be made available at a time to avoid overconsumption by individual animals. Even in summer when the practice is followed to "crowd" feeder animals it must be done on a day-to-day basis.

During recent years a self-feeding system which involves a protein meal mixed with salt as a regulator has been tested in a number of localities. The usual ratio of salt to cottonseed meal is 1 to 4. E. H. McIlvain and D. A. Savage working at the Southern Great Plains Field Station, Woodward, Oklahoma, found that yearling steers on winter range would take, ad libitum, 2½ pounds of this mixture. Over winter they gained 12 pounds per head less than comparable steers receiving 2 pounds of cottonseed cake per day and salt free choice on adjacent range. During summer the steers took ½ pound of salt for every pound of meal and the difference in per head gain was exactly the same as on winter range.

More recently, Walter Armer, animal husbandry specialist, University of Arizona, writing for "Better Farming Methods" (1)22:January 1950, pointed out that Arizona stockmen have used the salt-meal mixture in self-feeders for years and found it as good as the hand feeding system. Moreover it has saved them labor. Feeders can be conveniently located and filled periodically as needed.

Offhand, a half pound of salt per yearling steer per day seems like a lot. Over a long period of years at Miles City range cows with calves used an average of about 3/4 of a pound of a salt-bonemeal mixture per cow per month. During severe drought they used 2½ to 4 times that amount.

Concerning the high consumption of salt in the Woodward tests, McIlvain and Savage said, "It would appear that the quantity of salt, one-half pound, rather than the ratio of salt to meal, is the limiting factor in governing meal consumption on a self-fed basis. It is likely that greater quantities of salt may be necessary to govern meal consumption of larger steers and of cows". -- Northern Rocky Mountain Forest and Range Experiment Station release.

Maleic Hydrazide, A Selective Herbicide: H. B. Currier and A. S. Crafts, Botany Division, College of Agriculture, University of California, reports that the growth regulating properties of maleic hydrazide indicate this compound may prove to be a valuable selective herbicide.

Treated tomato plants stopped growth for several weeks after which normal growth was resumed with little apparent injury. The concentration used regulated the amount of inhibition. Two-week-old barley and five-week-old cotton plants were sprayed with 0.2 percent maleic hydrazide in water solution. Barley growth was stopped a few days after spraying. Leaves turned dark green and slowly died back from the tips. Six weeks after treating, the barley was completely dead but cotton was apparently unaffected.

This compound was found to affect various types of plants differently. Young plants have been noted to respond to a greater degree than older plants. Young water grass and Johnson grass plants sprayed with 0.2 percent maleic hydrazide stopped growing and died whereas the older plants survived. -- Science, Vol. III, No. 2876, Feb. 10, 1950, pp.152-3.

Pre-emergence Control of Bermuda Grass and Johnson Grass With 2, 4-D: Research efforts have long been directed toward finding an effective and economical means of controlling weedy perennial grasses. Early studies on Bermuda grass and Johnson grass show them to be resistant to the usual post-emergence applications of 2, 4-D. Young cells were found to be the most susceptible to the chemical. Studies using heavy applications of 2, 4-D when plant cells were mainly in a meristematic stage were carried out in 1948 and 1949, and reported by Glenn C. Klingman, Agronomy Department, North Carolina State College, Raleigh, North Carolina.

Heavily infested Bermuda grass and Johnson grass areas were treated at the rates of 10 and 20 pounds 2, 4-D acid equivalent per acre. Prior to treatment with the chemical the Bermuda grass area was divided into 3 parts: (1) burned, (2) heavily disked, and (3) undisturbed. One series of plots was sprayed before spring emergence and the second when about 50 percent of the plants had emerged. The Johnson grass plots received similar treatment but mowed plots were substituted for the burned plots.

On the pre-emergence plots heavy disking and no disturbance were equally effective in complete eradication of Bermuda grass when combined with 2, 4-D applications at the rate of 20 pounds of acid equivalent per acre. Occasional surviving plants were noted on the burned area. Stems and leaves that had emerged prior to treatment were stunted but continued to live. The 10 pound 2, 4-D acid equivalent rate was effective in killing Bermuda grass before emergence when the ground was well settled by rain prior to treatment. Observations indicated that a rain after disking settles the soil and may be needed to carry the chemical down to the rhizomes.

Similar results were obtained with Johnson grass as with Bermuda grass on disked and post-emergence plots. Mowing was only partially effective. -- Agronomy Journal, Vol. 41, No. 12, December 1949.

Sixty-Year-Old Sagebrush: The lowly big sagebrush (Artemisia tridentata) is both friend and foe throughout the western range country depending upon whose range it occupies, how much grass grows underneath it, and how deep the snow may be. Every rancher and range manager knows something about sagebrush; some of its merits and disadvantages on the range. How many know its life span? How long do individual plants live on the range in Montana?

During a study of competition between grass and big sagebrush W. E. Booth of Montana State College counted the annual growth rings in about 300 individual plants. The plants were taken from 3 separate areas in the Madison, Gallatin, and Trail Creek drainages and ring counts were from stem cross sections one inch above the ground. Of the total number of plants observed, 31.5 percent were in the 31-35 year age class. Numbers of plants by 5-year age classes, diminished both ways from this modal class. Less than one percent of the plants were under five years old. The oldest ones, again less than one percent of the total, were in the 56-60 year age class. Even though the history of the selected areas is incomplete it is known that they had recently been only lightly used by livestock and big game. These data indicate that under certain conditions, at least, big sagebrush will live to a ripe old age in Montana. -- From Proceedings Montana Academy of Science, Vol. 7 and 8, pp. 23-25.

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Range RESEARCH HI-LITES

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Chas. L. Tebbe - Director

Volume I, Number 12

April 20, 1950

Growth and Production Factors in Range Cattle: An analysis of 770 calves from 112 head of cows that had been in the breeding herds at the U. S. Range Livestock Experiment Station, near Miles City, for at least 9 years showed that breeding cows reached mature weight at approximately five years of age. There was but slight change in weight after 3½ years, however. Maximum calf birth weights were obtained from 4-year-old cows and maximum calf weaning weights from 6-year-old cows. From this study it seems the best producing years for a range cow are from 4 to 8 years of age. Cows should be culled from the herd at 10 years of age. -- From Montana Agricultural Experiment Station Bulletin 400.

Records of Performance in Hereford Cattle: An analysis of data from 181 steers carried in record-of-performance tests at the U. S. Range Livestock Experiment Station near Miles City showed apparent hereditary differences in ability to gain, in weight for age, and in conformation characteristics between the progeny of different sires. In the 1948-1949 test a difference of 101 pounds existed at weaning time between the progeny of the best and poorest bull. At the end of the seven months feeding period the spread in weight was 211 pounds. Groups of 8 calves from 13 different sires were involved in the test. There was a spread in net returns, above feed and marketing costs, of $45.00 per steer between the best and poorest bull. On eight steers, the best bull returned $320.00 more in one year than the poorest bull. Such differences are by no means exceptional, and it has been shown that most differences of this sort can be selected for by means of performance testing. -- From Montana Agricultural Experiment Station Bulletins 397 and 417.

Hi-Lights' Birthday: With this issue Range Research Hi-Lites becomes one year old. During the year 52 separate articles or items have been printed. These articles concerned many different range subjects. Nineteen of the items reported results of research conducted by the range division of the Northern Rocky Mountain Forest and Range Experiment Station. The remainder, 33 articles, concerned the published work of others and included three meeting notices. For your convenience, these articles are indexed, herein, by subject matter.

Four thousand twenty-five copies of Range Research Hi-Lites have been printed and nearly that number distributed. On the average 335 copies have been distributed each month. Recipients have been largely Forest Service field men, personnel of cooperating agencies, and stockmen.

With the beginning of the new publication year, Range Research Hi-Lites will be incorporated as a part of Research Hi-Lites, a Station-wide release which will be issued twice each month. This will not affect the usual schedule of range items. For the remainder of 1950, at least, one number of Research Hi-Lites each month will be devoted entirely to range information.

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Salt consumption by cattle in southwestern Montana. NRM release. No. 8, December 20, 1949.
Sheep eat minerals because they like them. New Zealand Journal of Agriculture Vol. 79, No. 6, p. 583, 1949. No. 10, February 1950.
Salt-meal mixture saves labor. NRM release. No. 11, March 20, 1950.

The material which has appeared in Range Research Hi-Lites during the past year has been contributed by the Division staff which consists of:

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Evanko, Anthony B. - range conservationist, in charge, Vigilante Experimental Range, Alder, Montana.
Harris, Grant A. - range conservationist, Inland Empire Research Center, Spokane, Washington.
Peterson, Roald A. - project leader, Artificial Revegetation, Missoula, Mont.
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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

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RESEARCH HI-LITES

FOREST MANAGEMENT
FOREST UTILIZATION
FOREST ECONOMICS
Volume II, Number I

RANGE MANAGEMENT
FOREST FIRE CONTROL
FLOOD CONTROL SURVEYS
May 1, 1950

Prepared in the Division of Flood Control Surveys

"The relation between cover conditions and water resources is close and continuous; both simple and complex; often not understood and frequently misrepresented. It is not always the same. It varies with the season, topography, soil, climate and the type and character of the forest itself. It varies also with time."--E.N. Munns.

Following are definitions of some terms frequently used when considering the relationships between vegetational cover and water:

Flood Control Surveys are concerned with investigations of watersheds and measures for runoff and water flow retardation and soil erosion prevention on watersheds. Congressional legislation provides that these investigations be carried out under the jurisdiction of and be prosecuted by the United States Department of Agriculture. As a result Flood Control Surveys Divisions have been established in the Forest Service and the Soil Conservation Service.

Forest and Range Influences Research is concerned with investigation of the effects resulting from the presence of forest or range vegetation upon climate, soil water, runoff, streamflow, floods, erosion, and soil productivity. -- Adapted from Forest Influences by Joseph Kittredge.

Watershed Management is the administration and regulation of the aggregate resources of a drainage basin for the production of water and the control of erosion, streamflow and floods. -- Forestry Terminology, S.A.F. 1944.

Multiple Use Forestry is the practice of forestry which combines two or more objectives, such as production of wood or wood-derivative products, forage and browse for domestic livestock, proper environment conditions for wildlife, landscape effects, protection against floods and erosion, recreation, and national defense. -- Forestry Terminology, S.A.F., 1944.

Effect of trees on snow accumulation and rate of melt is indicated by snow measurements made in a number of openings and in adjacent timber stands of varying density at the Priest River Experimental Forest during the winter of 1948-49. The greatest extreme in cover conditions was sampled on a flat where an open area was compared with an old, very dense stand of hemlock. The maximum accumulation of snow occurred on the same date, late in February, on both areas. At that time there were only $7\frac{1}{2}$ inches of water in the snow pack under the timber, but almost 10 inches of water in the open area. Thus, snow accumulation in the forest area was $2\frac{1}{2}$ inches, or 25 percent, less than it was in the open area. Melting was much faster in the open area; and even though it had more snow to begin with, it was bare more than 15 days earlier than the timbered area. -- Unpublished-Northern Rocky Mountain Forest and Range Experiment Station.

Vegetation controls surface runoff and erosion but also reduces amount of water available for streamflow because of water used for plant growth. Studies conducted in the Wasatch Mountains near Farmington, Utah, by the Intermountain Forest and Range Experiment Station have been reported by A. R. Croft. They showed that a good cover of aspen with an understory of grass successfully prevented surface runoff and soil erosion during fifteen years of record at an average water cost, for evaporation and transpiration, of about 12 inches per year. Herbaceous cover alone, on plots where aspen was removed, controlled runoff and erosion almost as effectively at a water cost of 8 inches. Plots from which all vegetation was removed lost only 3 inches of water per year but surface runoff and erosion took place at an alarming rate. During one summer, from these bare plots there was 0.68 inch of surface runoff (about 10% of the summer rainfall) which caused erosion at the rate of 10 tons of soil per acre.

Thus, since the bare plots lost 3 inches, mainly by evaporation from the bare soil surface, it appears that the grass cover controlled surface runoff and erosion for 5 inches of water. This is considered the minimum safe plant cover and is probably the minimum practical water cost for the site conditions studied.

The combined aspen and grass cover used about 9 inches more water than was lost from the bare soil and 4 inches more than the grass cover alone. This does not mean that it would be wise to remove all deep-rooted trees from our mountain watersheds, because many other factors such as the effect of trees on accumulation of snow and on time and rate of spring snow melt must be considered. -- Journal of Soil and Water Conservation, Vol. 5, No. 1, Jan. 1950.

Water is an extremely valuable and important product of national forest lands and demands a type of watershed management that will perpetuate this resource as a national asset rather than a liability. To give an idea of how water ranks in value with other products of the national forests, the following is quoted from "Summaries of Lectures given by Mont Saunderson at the Montana State University School of Forestry, School of Public and Private Administration, winter term, 1950."

> "Forest resources and forest production are important values, but they are not the dominant values. We can emphasize this by noting an estimate of annual product value of the several uses of these lands. The water value, if we use a figure of $1.50 per acre foot for the 200,000,000 acre feet annual water yield of the national forests, totals $300,000,000. The recreational use is estimated for the year 1947 at $20,000,000, and, for the same year, the timber sales amounted to approximately $18,000,000. Grazing receipts for this same year totaled approximately $3,000,000. In the Western States, the national forest lands are the main water sources. The western mountain lands above 6,000 feet in elevation yield most of the water, and 20% of the land area west of the 100th meridian, yields 80% of the water available for irrigation, industry, power and city uses."

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Volume II, Number 2

May 15, 1950

Prepared in the Division of Range Research

Reseeded Grasses Restore Soil Organic Matter: In semiarid southeast Idaho at 6,200 feet elevation wheat-fallow farming has, after 25 years, reduced soil organic matter and nitrogen about 50 percent below that of the native sod. This soil deterioration is a threat to continued production. Results from growing grass to restore soil condition were recently reported by R. H. Stark, A. L. Hafenrichter, and W. A. Moss.

Several grasses, including Fairway and standard crested wheatgrass, bluebunch wheatgrass, smooth bromegrass, intermediate wheatgrass, sheep fescue, Sherman big bluegrass, pubescent wheatgrass, and orchardgrass were grown. Six years after planting the following observations were made: (1) soil from all grass plots was higher in organic matter than soil continually farmed by the wheat-fallow method; (2) big bluegrass, pubescent wheatgrass, smooth brome, Fairway crested wheatgrass, and intermediate wheatgrass had restored soil organic matter equal to that of the native sod; (3) Sherman big bluegrass produced the highest yield of both tops and roots; (4) bluebunch wheatgrass was better adapted than either of the crested wheatgrasses; and (5) soil weight per cubic foot ranged from 6 to 17 pounds less on the grass plots than on wheat-fallow land - indicating increased soil porosity under grass. -- Agronomy Journal, Vol. 42, No. 3, March 1950.

Big Bluegrass Earliest Grass: Observations of reseeded species near Florence, Montana, during the last three years have consistently shown that big bluegrass is the earliest of the many grass species tested in this area so far. On March 16 of this year large green leaves of big bluegrass averaged 4 inches long, compared to a more sparse growth of about 3 inches for such early grasses as crested wheatgrass, beardless wheatgrass, and mountain brome. Not only is big bluegrass extremely early but has been found to be a high producer where rainfall is between 10-20 inches. Its main weakness for grazing appears to be the tendency toward easy uprooting by livestock, especially in early spring when soil is moist. -- Northern Rocky Mountain Forest & Range Experiment Station release.

Progress On Goatweed Control: Spring observations of the 20-acre goatweed control experiment installed last year near Colville, Washington, indicate that the treatment is effective. While it is too soon to draw final conclusions, early results look promising.

The experimental area was treated with borascu at the rate of four pounds per square rod in May 1949. This is a much lighter application rate than is usually

recommended, and may not be heavy enough to control goatweed infestations on soils of textures different than those on which the test was made.

Old plants and seedlings of goatweed appeared to be dead over a major part of the treated area. However, in a few local spots (usually five or six feet in diameter) some plants of the weed were alive. These spots may have been missed when the borascu was applied. Perhaps a retreatment of some spots will be necessary. Goatweed on adjacent untreated check plots was growing vigorously.

The experimental area was seeded to a mixture of crested wheatgrass, smooth brome, and sheep fescue in late April 1950. Seeding of good forage grasses is necessary to fill in quickly the bare areas left by the goatweed, not only to aid in the control of the weed, but also for erosion control and to increase the grazing capacity of the treated area. -- Northern Rocky Mountain Forest & Range Experiment Station release.

Northern International Mountain Section of Range Management Society Organized: Another big step for furthering range management was taken April 29 when the Northern International Mountain Section was formally organized at Helena, Montana. Membership is open to members of the Society who have an interest in range problems of the area. The Section will devote itself to furthering understanding of range land-management problems, especially in the northern mountain area.

Twenty-six members participated in this meeting, despite an unseasonal snowstorm which blocked several roads. Officers elected were Tom Lommasson (Forest Service), Missoula, chairman; W. R. Hanson (Eastern Rocky Mountain Conservation Board), Calgary, Alberta, and Tom Williams (rancher), Radersburg, Montana, vice-chairmen; A. D. Moir (Forest Service), Helena, secretary-treasurer. Council members include Del Steed (agricultural agent), Cardston, Alberta, Ray G. Johnson (Extension Service), Bozeman, Montana, and Byron A. Smith (rancher), Helena.

One general meeting and one field meeting is planned for each year. The field meeting is scheduled for early September at Waterton Park, Alberta, and will include a trip over ranges in the Alberta National Forest. -- Northern Rocky Mountain Forest & Range Experiment Station release.

Ponderosa Pine Browsed Heavier By Deer Than Douglas Fir: In a study of conifer browsing by deer on heavily stocked winter deer range in northwestern Montana, Lowell Adams found 38 percent of the ponderosa pine under 10 feet in height browsed compared to only 21 percent of the Douglas fir reproduction. Of the browsed trees, 39 percent of the foliage of the pine had been removed on the average, while approximately 32 percent of the fir foliage had been utilized. Heavier use of the ponderosa pine reproduction tends to favor the economically inferior fir. Remedies proposed are: (1) improved silvicultural practices to favor the pine, and (2) adjustment of deer numbers to allow recovery of broadleaf browse species on the deer range. -- Journal of Forestry, Vol. 47, No. 11, November 1949.

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Volume II, Number 3

June 1, 1950

Prepared in the Division of Forest Management Research

Soil preparation measures to encourage natural regeneration should be synchronized with seed production.

Prescribed burning and mechanical scarification of the forest floor aid germination and initial establishment of trees by exposing mineral soil and destroying competing vegetation. Practically all native conifers reproduce more abundantly and promptly on prepared seedbeds. However, trees bear abundant seed crops only at irregular intervals. In order to assure most effective use of prepared seedbeds, they should be made ready shortly before dispersal of a seed crop from the desired species of tree. If seedbeds are prepared during a year of poor seed production, the beneficial effects may be largely lost before a seed year occurs. Similarly, if seedbed preparation happens to be timed with seed dissemination by a less desirable species, the wrong crop is likely to result. Data from seed production studies in partially cut stands on the Kootenai National Forest give an indication of the possibilities for synchronizing seedbed preparation with seed production.

Species	(per acre) Sound seed disseminated		(basis, 20 seed traps) Composition of overstory	
	1948	1949	Trees	Average diameter
	(Number)	(Number)	(Number)	(Inches)
Ponderosa pine	75,600	7,800	12.5	18
Douglas-fir	3,800	79,600	14.5	14
Western larch	2,200	5,000	2.0	20

In the example cited above, 1948 was a good year in which to prepare the ground for natural seeding. On the other hand, the light crop of pine seed and the relatively heavy crop of Douglas-fir in 1949 made that year a poor time for encouraging regeneration.

Preliminary data on natural reseeding in lodgepole pine clear cuttings, Lewis & Clark National Forest.

In August 1949, the Station began a study of natural regeneration by lodgepole pine in recent clear cuttings on the White Sulphur Springs District of the Lewis

and Clark National Forest in cooperation with local forest officers. Before starting new experimental work, reproduction was examined on areas which had been logged during 1946. The findings are shown in the following tabulation.

Soil surface conditions	Percent total area	Percent milacre quadrats stocked	Seedlings per acre	Basis (quadrats)
(1) No slash disposal. Aspect, W.; slope, 25-45%.				100
Natural surface and light slash	76	78	3,090	
Skid road	9	78	16,700	
Heavy slash	15	0	0	
(2) Slash broadcast burned in fall, 1947. Comparable with (3) below. Aspect, S.; almost level.				100
Natural surface and light slash	34	59	3,748	
Burned surface	66	9	91	
(3) No slash disposal. Compare with (2) above. Aspect, S.; almost level.				100
Natural surface and light slash	69	58	1,207	
Skid road	7	25	250	
Heavy slash	24	14	349	
(4) Broadcast burned 1947. Fire ran into patch of adjacent standing timber, killing it. Aspect, S.W.; slope, 5-10%.				
Burned cut-over area (1 chain from edge of timber)	—	23	600	30
Burned standing timber	—	97	9,033	30
(5) Comparison of vegetative cover, burned spots excluded.				50
Grass (South aspect, 4% slope)	—	68	2,820	
Huckleberry-bearberry (SE, 20% slope)	—	86	4,351	

It seems evident from these data that during the relatively favorable growing seasons of 1947 and 1948, lodgepole pine regenerated rather well on the natural forest floor and skid roads following clear cutting. Heavy slash inhibited reproduction, and broadcast burning of slash greatly curtailed reproduction, presumably by destroying seeds in the cones and on the ground. The single small sample of reseeding on grass-covered surface (5) may be too limited to represent accurately this kind of cover, but it appears to show satisfactory initial regeneration. It remains to be seen if the seedlings will survive and overtop the grass.

# # # # #

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Volume II, Number 4

June 15, 1950

Prepared in the Division of Range Research

Prolonged Grazing Lessens Idaho Fescue Production: Four areas, representative of bunchgrass range and protected from livestock grazing from 14 to 25 years were compared with adjacent spring range open to grazing at the Vigilante experimental range. In every instance current production of Idaho fescue herbage was highest in the protected areas, averaging more than twice as much as those exposed to grazing. This was true despite correction of data for limited current grazing in the outside areas.

Comparison	Yield of Idaho Fescue 1949		Percent grazed of protected
	Protected (Lbs./acre)	Grazed (Lbs./acre)	
A	640	295	46
B	549	205	37
C	573	268	47
D	104	60	58
Average (all areas)	466.5	207.0	47.0

The observations on this important forage species show the extent to which many years of spring grazing - in some cases heavy - can retard production. It also points to the critical need for determining management methods and establishing rates of grazing which will result in forage yields closer to the potential. -- NRM Forest & Range Experiment Station release.

Crested Wheatgrass Heavy Producer of Root Fibre: In a study of relative root fibre production of slender wheatgrass, crested wheatgrass, and smooth bromegrass in Saskatchewan, Canada, T. M. Stevenson and W. J. White found crested wheatgrass superior to the other two grasses.

The weight of root fibre produced by crested wheatgrass in the top foot of soil increased from year to year. More than 2,600 pounds of root fibre per acre were found in one-year-old stands. This increased to about 4,000, 6,000, and 8,100 pounds in three-, five-, and seven-year-old stands. Five-year-old stands built up to about one-half, and seven-year-old stands to two-thirds, the quantity of root fibre present in lightly grazed native prairie. Some variation in root fibre production between strains was noted. Fairway usually out-yielded the standard strain.

Smooth bromegrass built up root fibre production in a manner similar to crested wheatgrass. Up to five years of age production was only slightly less than for crested wheatgrass of the same age.

In contrast, the root fibre yield of one-year-old stands of slender wheatgrass was much less than for crested wheatgrass or smooth bromegrass and the rate of increase in subsequent years was less rapid. Roots of slender wheatgrass appeared to be short lived and a high proportion of them probably died each year.

About 88 percent of the root production was in the first foot. Of this about 50 percent was contained within the top 3 inches, 25 percent in the 3 to 6 inch layer, 15 percent in the 6 to 9 inch layer, and 10 percent in the 9 to 12 inch depth.

These results indicate the relative effectiveness of these three species in rebuilding the root fibre content of deteriorated range soils and give some idea of the length of time required to restore the original root fibre content. -- From Scientific Agriculture, 22:2. October 1941.

Grasses and Soils: Evidence that grasses will improve depleted or abandoned cropland soils is accumulating steadily (see May 15, 1950, issue of Hi-Lites). The effect of grasses on soil nitrogen and organic matter content seems to be related to the grass species and to the age of sod according to results from a study made by J. R. McHenry and L. C. Newell in eastern Nebraska.

Five-year-old stands of crested wheatgrass, smooth bromegrass, bluestem wheatgrass, and Russian wildrye, all cool season grasses; seven-year-old stands of smooth brome, Kentucky bluegrass, and orchardgrass, also cool season grasses; and seven-year-old stands of such warm season species as buffalograss, blue grama, sideoats grama, big bluestem, and switchgrass, were compared with cultivated and weedy areas.

Every one of the 11 grasses had substantially raised the nitrogen and organic matter in the top six inches of soil above that of the weedy plots and the cultivated field. There was no positive difference between cool and warm season grasses, although considerable variation existed between species. Blue grama, orchardgrass, and bluegrass were outstanding in the increase of soil nitrogen in the seven-year-old stand, and bluestem wheatgrass and Russian wildrye in the five-year-old stand. Production of soil organic matter by species was somewhat similarly related. Nitrogen and organic matter production by bromegrass, which occurred in both stands, was highest in the seven-year planting. Crested wheatgrass rated surprisingly low. In view of the high root fibre production of crested wheatgrass reported in the preceding item the poor showing may be due to inferior adaptation to eastern Nebraska conditions.

Results similar in principle were reported in 1945 by J. W. White, F. J. Holben, and A. C. Richer in Pennsylvania. They found that at the end of 72 years of continuous cultivation soils on 20 different plots were all considerably lower in nitrogen and organic matter than adjacent unfertilized grassland soils. Differences ranged between 12 percent where cultivated plots had been heavily fertilized, to 68 percent where the plots had not been fertilized. Similar but less extreme differences were found between plots 54 years old and grassland. On grassland annual increases in soil nitrogen and organic matter per acre between 1907 and 1938 averaged 32.3 and 541 pounds, respectively. Though these increases are probably considerably greater than might be expected in a semiarid climate, they illustrate a basic principle. -- Journal of Am. Soc. of Agronomy, Vol. 39, No. 11, Nov. 1947, and Vol. 37, No. 1, Jan. 1945.

treated plant showed some degree of disturbance - many showed current growth only along the mid-ribs of old leaves. These preliminary observations indicate that 2, 4-D may be a useful tool in controlling mules-ears. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Differences in Site and Seedbed Effect Grass Seedling Emergence: Last fall, two sets of experimental grass plots about 50 yards apart were seeded in the Bear Gulch area, at about 7,000 feet of elevation southwest of Dillon, in cooperation with the Beaverhead National Forest. Ground preparation was limited to plowing with an offset disk. Seeds were broadcast in the freshly plowed loose soil and were not covered.

One series of plots (number 1) sloped toward the southwest, the other (number 2) toward the northwest. Before plowing number 1 had big sagebrush and a fair amount of native grass on it. Number 2, on the other hand, was occupied mostly by dandelion. As a result the seedbed of the number 1 plots was much more soddy, the soil less friable, and generally drier due to exposure than the other plots. The influence of seedbed condition and exposure on seedling emergence this spring is shown in the following table:

Species	Plots no. 1 Southwest exposure		Plots no. 2 Northwest exposure	
	No. of seedlings per square foot (Estimated)	Av. ht. in inches	No. of seedlings per square foot (Estimated)	Av. ht. in inches
Sheep fescue (hard)	10	1	60	1
Pubescent wheatgrass	1	1½-2	5	1-1½
Sherman big bluegrass	Less than 0.5	1	3	1
Meadow foxtail	1	1½-2	5	1-1½
Intermediate wheatgrass	1	1½-2	5	1-1½
Alta fescue	Less than 0.5	1½	10	1-1½
Average (all species)	2.3	1.5	14.7	1.2

This table shows that the soddy, southwest exposed plots produced only about 1/6 as many seedlings as the others. Relationships among species on each of the two plots were similar. Sheep fescue, which has shown a wide range in adaptation in other plantings, produced by far the greatest number of seedlings. Plants were taller on plots number 1, probably due to higher temperature and an earlier start.

Most of the seedlings observed had the seed buried ½ inch or more due to the action of snow, frost, water, and wind in moving the loose soil. More sheep fescue seeds germinated and established seedlings on the soil surface than any other species. -- Northern Rocky Mountain Forest and Range Experiment Station release.

Burning Injures Bitterbrush Less Than Sagebrush: Much concern has been expressed about the effect of controlled burning of sagebrush upon associated browse species, such as bitterbrush, which is valuable to both livestock and game. Considerable light is thrown on this problem by James P. Blaisdell, in a report on the "Effects of Controlled Burning On Bitterbrush On the Upper Snake River Plains".

Fifteen years after burning current production in pounds per acre of bitterbrush in relation to treatment was as follows: (1) unburned 311.2; (2) light burn 215.7; (3) moderate burn 147.6; and (4) heavy burn 156.8. In contrast big sagebrush was almost entirely eliminated by burning. The difference is accounted for by the capacity of bitterbrush to sprout after burning, a characteristic not possessed by big sagebrush. Thus it appears that burning of bitterbrush will not permanently eliminate it from the stand. -- Intermountain Forest and Range Experiment Station Research Paper No. 20, April 1950.

Mr Chapline

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume II Number 6 August 1, 1950

Duo-Kerf saw significantly reduces power requirements and waste in sawing operation. A new type saw developed at the Forest Products Laboratory at Madison holds considerable promise of overcoming some of the major shortcomings of our present day circular saw.

Through a unique arrangement of alternating chipper teeth with wider but slightly lower side-dresser teeth, the Duo-Kerf saw requires 20- to 25-percent less power. This is brought about largely by the lessened resistance to chip removal. This reduction in power requirement brings about a similar reduction in saw stresses, a major cause of inaccurate sawing, and makes it possible to use thinner gauged saws. The new saw also produces a relatively smooth surface and therefore requires a smaller allowance for dressing.

Inland Empire species prove suitable for veneer and plywood production. The decrease in the supply of available coast fir veneer quality logs has brought about a considerable search for new supply sources. With this expanded program more and more interest is being directed toward such woods as western larch, ponderosa pine, western white pine and Engelmann spruce. In anticipation of this action the Forest Products Laboratory, along with a number of industrial firms, conducted a number of tests on these species a few years ago to determine their veneering and plywood producing properties. The tests for the most part were very successful and proved that practically all of the above species were suitable. The recoveries of clear stock in Engelmann spruce were below what plywood producers consider minimum, but all other species yielded well above minimum. Western larch appeared to cut to best quality veneer when heated to approximately 150° F. Heating also appeared to soften the knots in ponderosa pine and thereby reduced possible knife damage. No problems were encountered in drying the various veneers. Plywood produced from the various species by both the hot and cold press methods appeared to be of high quality.

The possibility of further expansion of a veneer and plywood industry in the Inland Empire is further enhanced by relatively recent developments in veneer slicing and edge-gluing technique. Formerly considered feasible only in the case of the rarest cabinet woods, production of sliced veneer and plywood has been perfected to where it is competitive with other materials for such uses as wall paneling, doors and furniture items. Slicing permits the use of

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smaller logs, or sections of logs, and provides for matching grain patterns or developing certain figures in the grain. Quartered or vertical grain is readily produced by slicing. Sliced western larch veneer has alternate light and dark bands of wood that can be matched into most pleasing patterns - often presenting the golden brown color of yellow birch. Knotty pine panel face material is another product that can be produced advantageously by slicing.

Representative of the Wyssen Cable Logging firm of Switzerland will visit the Northern Rocky Mountain area. Mr. Wyssen, owner and manager of the Wyssen firm, and Dr. A. Huber, his chief engineer, plan to tour the United States in July and August. Purpose of their trip is to inspect a number of logging chances proposed for the installation of their equipment. The firm has one operation installed in New York and another in Canada. Reports indicate both installations are economically successful. However, neither installation is ideal for demonstrating the equipment to its fullest advantage. Upon reviewing topographic maps of the North Fork of the Flathead Forest, Wyssen Company officials expressed the opinion that this area was considerably better suited for the equipment than either of their present installations on this continent. Assuming a similar reaction to their on-the-ground inspection the firm hopes to negotiate an agreement with some logging firm in that area to log a timber tract as a demonstrational measure this season.

The cable logging system the firm produces is a combination high-lead skidding and aerial transportation system. It is composed of a single skyline cable about 1 inch in diameter, a 7/16 inch haulback cable, and specially designed carriage. The power unit consists of a 7- to 10-horsepower gas engine which operates a single drum winch for carrying the haulback cable. It is designed for logging steep mountain areas and is especially well adapted to logging areas where watershed values must be protected.

The system sells for approximately $13,000, complete with all accessories. It is designed to carry approximately 6000 pounds. Through the use of an ingenious system of intermediate supports an area of approximately 1½ miles long and 6- to 800-feet in width can be logged from a single setting. Resetting requires approximately two days with a four to five man crew. Damage to residual timber and soil is minimized and is said to be about the same as from horse logging.

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U.S. DEPARTMENT OF AGRICULTURE — FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Volume II, Number 7 — August 15, 1950

Prepared in the Division of Range Research

Recent Changes in Range Vegetation in Eastern Montana: Changes in range vegetation since 1948 were recently determined on seven separate areas in the bluestem wheatgrass subtype near Miles City. The past spring was late but otherwise rather favorable but 1949 was characterized by drought and grasshopper infestations. As a result of these conditions since 1948 valuable cool-weather grasses, such as bluestem wheatgrass, needleandthread, and green needlegrass, increased 50 percent in total surface area occupied. On the other hand, two warm-weather grasses, buffalo and blue grama, decreased to 57 percent of their 1948 density. The difference in growth habits plus the fact that the hoppers preferred the more succulent warm-season species and thereby grazed them heavier, accounts for the difference in response between warm- and cool-season grasses. Low-value cool-weather grasses, particularly Sandberg bluegrass and perennial weeds, such as wild lettuce, wild carrot, and vetch, increased materially during the two-year period. No significant change was noted in pricklypear cactus or big sagebrush on the sites studied. Total vegetal cover increased from 23.3 percent in 1948 to 26.5 percent in 1950, while the percent of ground surface covered with litter decreased during the same period from 38.4 to 22.2 percent. -- NRM Forest & Range Experiment Station release.

Crested Wheatgrass Hay: What about hay production by crested wheatgrass? That question is heard many times each year whenever ranchers and farmers meet. Many operators, particularly in the Plains, know the grazing value of crested from experience, but only a few have saved any for hay.

A few figures from the United States Range Livestock Experiment Station near Miles City, Montana, indicate what crested wheatgrass will do on dryland in the plains. A 417-acre field harvested in mid-June, when the crested was in the early flower stage, produced 669,226 pounds or 334.61 tons of good quality hay. Production per acre averaged 1,604 pounds or 0.802 tons.

This field, located on the first bench above the Yellowstone River and containing a wide variety of low-fertility, water-lain soils, was seeded to crested 6 to 8 years ago. It has been grazed and mowed in accordance with need since its second growing season. Precipitation at Miles City averages about 13 inches annually.

The hay was baled out of the windrow and weighed air-dry a few days after baling. John Love, Bureau of Animal Industry foreman, conscientiously counted and weighed bales to obtain this record of crested wheatgrass hay production. -- NRM Forest & Range Experiment Station release.

Base Seeding Rates on Percent Live Pure Seed: Grass seed purchased from a dealer or grower always contains some dirt, straw, chaff, broken seed, and other debris. The

percentage of such material determines the purity of the lot. If standard seeding rates are used without considering purity and the percentage of pure seed which will germinate, actual seeding rates are likely to be considerably less than desired.

J. F. Pechanec of the Pacific Northwest Forest and Range Experiment Station recently demonstrated how these important factors can be compensated for. Purity and germination for each lot of commercial seed are determined before sale. The product of these two percentages divided by 100 equals the percent of live pure seed in the lot. This percentage divided into 100 gives a factor which will convert the selected seeding rate to a live pure seed basis. For example, it is desired to sow 6 pounds per acre of crested wheatgrass seed that has a purity of 90 percent and a germination of 80 percent:

$$\frac{90 \times 80}{100} = 72 \text{ percent live pure seed.}$$

$$\frac{100}{72} = 1.39 \text{ conversion factor.}$$

ding rate, 6 pounds x 1.39 = 8.34 pounds actual seeding rate. Neglecting purity and germination the selected seeding rate, six pounds per acre, would have been more than 25 percent below the desired rate. -- Research Note #67, July 10, 1950, Pacific Northwest Forest & Range Experiment Station, Portland, Oregon.

Herbicides Not Harmful to Livestock: Results of an experiment to determine the effects of various herbicides on pastures and grazing livestock indicate that none of the herbicides used had any serious physiological effect upon the livestock involved. The livestock did not prefer the sprayed to unsprayed areas but on those areas sprayed with 2, 4-D herbicides they grazed the sprayed plots almost as well as the unsprayed.

e study conducted by B. H. Grigsley and E. D. Farwell, involved horses, beef cows, dairy cows, swine, and sheep. Herbicides used included three formulations of 2, 4-D, 2, 4, 5-T, two butylphenol formulations, pentachlorophenal and trichloroacetic acid. The authors concluded that since the rates used were 2 to 4 times greater than recommended applications, farm use of these materials for weed control seems reasonably safe. Article 32-49, reprinted from Michigan Agri. Experiment Station Quarterly, Vol, 32, No. 3, 1950.

Conservative Range Stocking Lessens Feed Requirements and Labor: Long-time cattle grazing studies conducted near Miles City have shown that moderate and light stocking reduce supplemental feed costs and save labor compared to heavy stocking. During the period 1932 through 1936, experimental cows on moderately and lightly stocked range required less hay by 571 and 731 pounds per head per year, respectively, than did similar cattle on heavily stocked range. From 1937 through 1945 other groups of experimental cows using the same range required 667 and 620 pounds less hay per head per year under moderate and light stocking than did the group on heavily stocked range.

Labor requirements showed up in the total number of days that feeding was necessary on winter range. In 8 out of 12 winters, cows on heavily stocked range required supplemental feed on more than 25 percent of the days spent on winter range. Feeding periods ran up to 25 percent of the days on winter range during only 3 of the 12 winters under moderate and light range stocking. Considering only the last 8 years of the experiment, cows on moderately and lightly stocked range had to be fed on one quarter of the days on winter range during only one winter while under heavy stocking such feeding was necessary during 6 of the 8 winters. From the standpoint of wintering costs alone, conservative stocking is advantageous in lower supplemental feed requirements and smaller labor costs compared to heavy stocking. -- NRM Forest & Range Experiment Station release.

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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume II, Number 8 September 1, 1950

Prepared in the Division of Fire Research

New Rate-of-Spread Factors Established for Fuel Classification System. The present R-1 fuel classification system subdivides all fuels into four rate-of-spread types described as low, medium, high, and extreme. Studies of over 12,000 fires have indicated the need for a fifth rate-of-spread type to take care of the very fast traveling fires found in dry bunch and cheat grass and the worst logging slash fuels. This new rate-of-spread type has been termed "flash." These same studies have also indicated that somewhat higher rates of spread may be expected at a burning index of 70 than those shown by present standards. Rates of spread for each fuel type for the old and new standards are compared below. The figures represent the maximum rates of spread for 85 percent of the fires during the first five hours after discovery:

Fuel Type	Rate of Spread at B.I. 70 in Chains Per Hour Perimeter Increase 1/	
	Present Standard	New Standard
Low	6	8
Medium	8	10
High	10	28
Extreme	20	35
Flash	Not classified	65

1/ Only 15 percent of the fires in each type will spread faster than the rates shown. This means that the odds are nearly 6 to 1 against higher rates of spread.

Fuel Classification Key Developed for Logging Slash. C. K. Lyman of the Lewis and Clark National Forest, while on detail to the Division of Fire Research, has developed a key for classifying rate of spread in logging slash fuels. Its use is similar to a botanical key. First, the key subdivides slash by species as follows:

1. Cedar Slash

2. Ponderosa Pine Slash -- in open stands where grass and duff are significant rate-of-spread factors.

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3. White or Ponderosa Pine Slash -- in mixture with slash from other species where larch comprises 60 percent of the cut and grass is not a major rate-of-spread factor.

4. Larch-Douglas fir and Lodgepole Pine Slash -- where grass is not a major rate-of-spread factor.

After the proper species determination has been made, the key aids in rate-of-spread classification by subdividing according to arrangement, percent of coverage, and quantity of slash. Under this system rate of spread may be classified from medium in situations where the arrangement is patchy, a small percent of the area is covered, and the quantity is light, to flash under the worst conditions. A publication containing these keys will be issued as soon as necessary field tests of the system can be completed.

Lightning Fire Occurrence Varies According to Elevation. During recent fire behavior studies the ignition rates of lightning fires were found to vary significantly according to elevation. In making these studies large maps were prepared showing the area in each 1000-foot elevation zone in the national forests of Region 1. With these maps as a base the annual number of lightning fires per million acres in each elevation zone was determined from data gathered on over 18,000 fires. Ignition rates of over 175 fires per million acres were found in the upper elevations of forests in northern Idaho. The average annual lightning fire occurrence per million acres in the national forests lying east and west of the Continental Divide is as follows:

Elevation Zone	Eastern Forests	Western Forests
1000-1999 feet		10.95
2000-2999 "	---	32.53
3000-3999 "	30.45	50.79
4000-4999 "	8.10	66.99
5000-5999 "	10.12	73.72
6000-6999 "	6.96	69.26
Over 7000 "	5.53	36.00

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Volume II, Number 9 September 15, 1950

Prepared in the Division of Range Research

Another Noxious Plant Threatens Montana Ranges: Halogeton, a poisonous plant resembling Russian thistle has crossed the Wyoming-Montana boundary and now threatens to invade Montana range lands. Reported last year by the Bureau of Land Management from the vicinities of Cody and Frannie, Wyoming, it has now been found in Montana directly north of Frannie, Wyoming. How serious this danger may be and what possibilities there are for control are as yet unknown. -- NRM Forest & Range Experiment Station release.

Twofold Moral: G. E. Blackman, professor of rural economy, University of Oxford, says that developments over the last decade in selective weed control point a twofold moral. "Just as it is sound husbandry to practice crop rotation, it is also good farming to practice a rotation of herbicides. The second moral is that although the mixing of two different types of herbicide may lead to the immediate killing of a wider range of weeds, there is a future risk of selecting types resistant to both compounds." Already in California native roadside vegetation has been replaced, as a result of spraying with mineral oil, by oil-resistant umbelliferous weeds and in fields monocotyledonous weeds resistant to 2, 4-D have replaced susceptible dicotyledonous weeds. -- Inaugural Fernhurst lecture, Royal Society of Arts, March 1, 1950.

Erosion Pavement Tends to Equalize Surface Erosion On Varying Degrees of Slope: Often noticeable on steep hillsides or heavily grazed areas, erosion pavement is the accumulation of rock fragments on the surface of the soil after the finer soil particles have been eroded, according to W. C. Loudermilk and H. L. Sundling. Using five lysimeters with gradients varying from 5 to 20 percent, it was found that initial applications of rainfall produced more erosion on the steeper slopes. However, the rates of erosion were not constant throughout the period of rainfall. As the rain continued the amount of erosion was reduced until an equilibrium was reached and the rates of erosion from all gradients became approximately the same. This significant fact was attributed to the formation of an erosion pavement. Thus, erosion pavement not only indicates past accelerated erosion, but it is nature's way of equalizing erosion on varying degrees of slope. -- Trans. Amer. Geo. Union 31(1):96-100, February 1950.

Yield Increases With Soil Depth: A study of corn yield by R. T. Odell has shown that yield increased 1.14 to 3.14 bushels per acre, depending upon soil type and

season, for each additional inch of surface soil. Increased yields were most pronounced where depth of surface soil was between 2 and 6 inches. This suggests that especially with the relatively shallow soils, as found on western ranges, special care must be taken to hold the top soil, if yields of forage are to be maintained at a maximum. — Journal of Agronomy, Vol. 42, No. 6, pp. 282-292, 1950.

Kangaroo Rats On the Range: In reporting the relationships between Merriam kangaroo rats and range vegetation in southern Arizona, Hudson F. Reynolds points out that control of rodents on the range only enhances the possibility of seed germination. Livestock must be controlled to assist in plant survival.

Throughout the study greater numbers of rodents were taken on grazed areas than on areas protected from livestock grazing. For all protected areas there were 2.0 kangaroo rats per acre on the average and the perennial grass density was 0.9 percent. Outside where livestock grazed there were 7.4 rats per acre and perennial grass density averaged only 0.4 percent. In every case as grass density increased rat numbers declined.

Seeds were found in cheek pouches more often than any other plant part. Grass seeds comprised the bulk of the material, forb seeds were second in abundance, and woody plant seeds third. Large seeds were preferred to small ones.

These facts warrant thorough consideration from the standpoints of range improvement and management. In reseeding, for example, only those species which have relatively large seed - fewer than 500,000 per pound - are likely to be appreciably influenced by kangaroo rats. During poor seed years the rats might eat nearly all the seed produced but in the good seed years their seed storing activities may place more seed in places favorable for germination. In consideration of range condition, higher grass densities are associated with better range conditions and since Merriam rats increase with a decrease in grass density their effect would become progressively greater as range conditions become poorer. — Ecology, Vol. 31, No. 3, July 1950.

Tall Larkspur Resists 2, 4-D: Re-examinations of tall larkspur plants sprayed with 2, 4-D in July 1949 indicate that the herbicide has little permanent effect on the growth processes of this poisonous range species. Plants in five different stages of development, (1) vegetative, (2) late bud, (3) full bloom, (4) late bloom, and (5) early seed were sprayed with each of 3 concentrations, 2,000, 4,000, and 6,000 parts per million, of 2, 4-D in water. Only very light kills of plants sprayed in either the late bud or full bloom stage were experienced. With the 2,000, 4,000, and 6,000 ppm. treatments 4, 8, and 2 percent of the plants, respectively, in these two developmental stages were killed by the herbicide. Not a single plant was killed by spraying with any concentrations at any other stage of development. In contrast, 10 percent of the unsprayed or check plants died of causes other than spraying. The loss was highest among the plants which were in the vegetative stage when observed. Further analyses of the data are expected to reveal the reasons for these unusual results. — NRM Forest and Range Experiment Station release.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Volume II, Number 10 October 1, 1950

Prepared in the Division of Flood Control Surveys

"Erosion control is as much a problem of water as of soil, for its causes are found in the destructive behavior of water arising from man's carelessness. We do not save the soil by disregarding the water factor, but by handling the soil in such a manner that the water falling on it behaves itself." -- Morris L. Cook, Administrator, R.E.A. before Ecological Society of America and AAAS, Rochester, New York, June 18, 1936.

One important cost of increased surface runoff frequently overlooked by many who are otherwise erosion and flood conscious is pointed up by Reed W. Bailey, Director, Intermountain Forest and Range Experiment Station, Ogden, Utah. In an article "Watershed Management: Key to Resource Conservation" in the September 1950 Journal of Forestry, he says in part, "Overland flow rushes off the land, and moisture so essential to production of forage and timber is lost."

This concept is extremely important. All too frequently consideration is given only to the fact that water running down skid trails or off overgrazed range lands is likely to carry soil with it and to add to peak flood flows in the streams below, without full realization that this runoff is also robbing the vegetation of water vitally needed for growth. In areas of limited rainfall, such as most of the grazing and much of the forest land in the Northern Rockies, accelerated loss of water by surface runoff may alone cause serious site quality deterioration.

Measurement of precipitation on wind-swept slopes. Last fall a battery of four gages was installed near the summit of Gisborne Mountain on the Priest River Experimental Forest. The following catches of precipitation (mainly snow) were made during the period November 8, 1949, to January 3, 1950:

Description of Gage	Total Catch	
	Inches of water	Percent
Standard 8 x 24-inch - no windshield	4.29	100
Standard 8 x 24-inch with standard horizontal shield	7.76	181
Gage with orifice cut to slope of ground surface - no windshield	12.81	299
Gage with sloped shield and orifice cut to slope of ground surface	16.26	379

There is general agreement among weather experts that the efficiency of a gage can be judged by the amount of catch. The above figures point out some problems, not only in choice of locations for gages, but also in the interpretation of many recorded data -- Unpublished-Northern Rocky Mountain Forest and Range Experiment Station.

The development of our water resources is closely tied up with the development of the land, although power development and navigation might appear to be somewhat independent of the land. But in a larger sense, the runoff and the watershed are inseparably interrelated and interdependent. -- From the report of Montana State College Committee to the Water Resources Policy Commission.

Local summer storms. The Northern Rocky Mountain Region commonly has been considered to be relatively free from intense summer rainstorms or "cloudbursts." Nevertheless, during the last year or two numerous reports of the occurrence of cloudbursts have been reported to the Flood Control Surveys Division. In the interest of learning more about the flood and runoff characteristics of the region, several of these storm areas have been investigated. Highly significant is the fact that most of the storms reported occurred on deteriorated lands which showed evidence of abnormal runoff.

In one instance, a rancher reported that his mountain rangeland had been damaged by three summer storms in five years. It was found that the cloudburst evidence was confined mainly to the fenced area of a range that had been extremely closely grazed this year and obviously for many years past. In addition to considerable soil loss from the range itself, about two acres of farmland below were covered with rocks and gravel; irrigation ditches were plugged and washed out; and grain crops were laid down by running water. In contrast, it was difficult to find any evidence that a rainstorm had occurred just across the fence on another piece of range where more conservative grazing had been practiced. Evidence of this "square cloudburst" seemed to be confined to the fenced range.

In another instance a storm occurred on a forest area severely burned in the fall of 1949. Here a dry stream channel of a drainage some two or three miles long was cut and eroded throughout its length by a rainstorm early in August. The flow of water, mud and rocks scoured the bark from the upstream face of medium-sized pine trees growing in the channel, to a height of three to five feet. Some were washed away entirely. On the burned, formerly timbered slopes, evidence of soil erosion was everywhere. In the few unburned islands there was no evidence that an intense rainstorm had occurred.

No doubt real "cloudbursts" do occur in the region, but when damages occur they should be a reminder to look again at the condition of the watershed before attributing the damage to "an act of God." It may be another man-made "square cloudburst." --Unpublished-Northern Rocky Mountain Forest and Range Experiment Station.

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MISSOULA, MONTANA

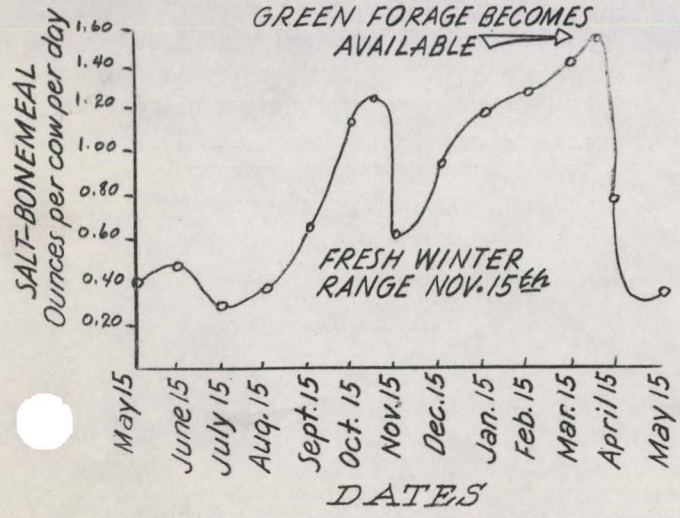
Volume II, Number 11 October 15, 1950

Prepared in the Division of Range Research

Salt Use By Range Cattle: How much salt will a range cow use? How is that use of salt related to succulence or maturity of vegetation? These questions have been discussed by stockmen and range managers since salting cattle on the range began.

Jardine and Anderson reported in USDA Bulletin No. 790 (1919) that on national forest ranges salt needs were highest when forage was lush and green and declined rapidly with curing. Chapline and Talbot confirmed this in USDA Circular No. 379 (1926) and recommended 2 to 2½ pounds of salt per cow per month for spring and early summer and only one pound per head per month during the balance of the year.

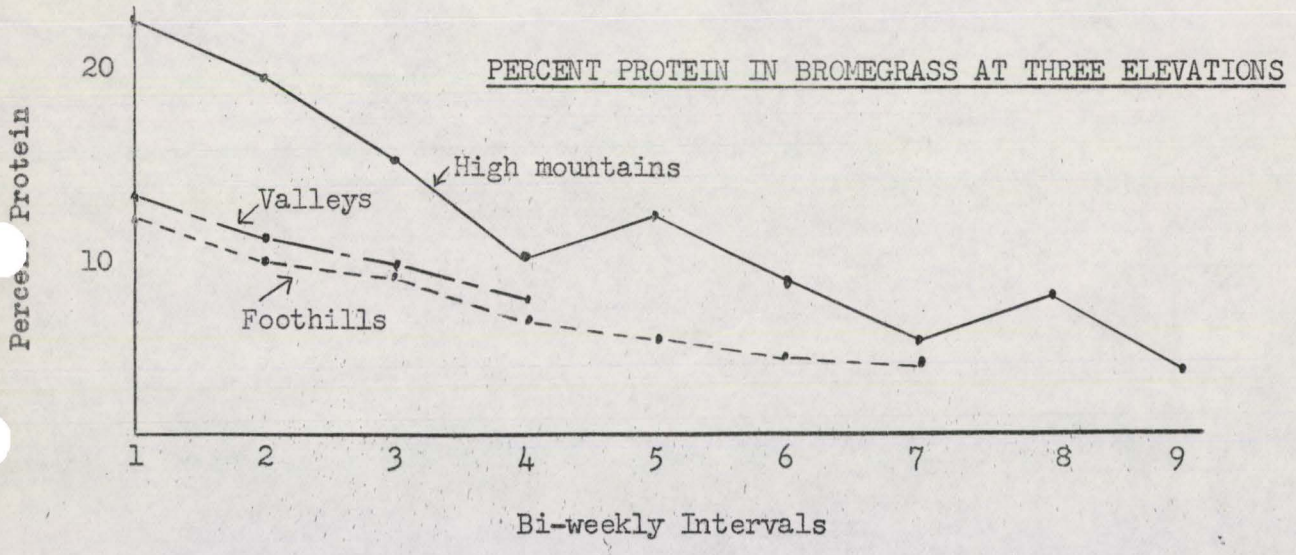
Other recent studies with cows and calves have shown them taking 0.93 pounds per head per month on New Mexico ranges, 0.6 pounds on the Custer National Forest in eastern Montana, and from 1.5 to 2.5 pounds per month on cut-over pine ranges in California. In all these cases, however, there has been a tendency toward higher use of salt with dry, mature forage. In a grazing study near Miles City, Montana, cows used 19 pounds of a 3 to 1 mixture of salt and bonemeal per head per year. Use varied with weather and the condition of vegetation but was highest when the vegetation was dry and the plants dormant. The following figure shows the average seasonal use of the salt-bonemeal mixture during the summers of 1940 through 1944 and winter of 1944-45.



The contradictory nature of these results point up the need for (1) applying findings which have been obtained on similar range and (2) more research in which salt use is related to kind and condition of the vegetation. -- NRM Forest and Range Experiment Station release.

Mountain Grazing and Animal Nutrition: It has long been known that range forage plants produce highest animal gains during the spring and early summer while they are green and growing. After the grasses cure animal gains drop off, and in wet cows especially, weight losses are likely to occur. These changes have also been found to be associated with the protein, phosphorous and digestible nutrient content of plants. Recent studies by the Intermountain Forest and Range Experiment Station on the influence of elevation on plant protein and phosphorous help to explain the special value of mountain grazing for prolonging animal gains.

The researchers sampled reseeded species, smooth bromegrass, crested and slender wheatgrasses, and the common legume, American vetch, in high mountains (8,000 - 10,000 feet), in the foothills (7,500 feet), and in the valleys (5,800 feet). Seasonal trends for each species and elevation were similar. However, on any given date protein and phosphorous content was higher in the high mountains than at lower levels (shown for protein in graph). This suggests that when herds are grazed first in the lowlands and then moved to higher elevations - as is a common practice in the mountain sections - they are maintained on highly nutritious forage for a longer period of time than would be possible normally if grazing were restricted to the lower levels, and helps to explain the high gains frequently reported for animals on mountain range.



-- Annual Report 1949, Intermountain Forest & Range Experiment Station.

Another Cattle Disease: Mycatic stomatitis, otherwise known as sore mouth, sore tongue or simple foot-and-mouth disease, has appeared in range animals at the United States Range Livestock Experiment Station near Miles City, Montana. About a dozen range cows have been affected to date by this sporadic, noninfectious disease.

The name "stomatitis" signifies an inflammation of the mucous membrane of the mouth and "mycatic stomatitis" refers to that form of inflammation which results from eating forage or feed containing irritant fungi. The disease may affect cattle of all ages that are on pasture or range. Mortality is low and the disease runs its course in about ten days unless complications occur from lack of care.

The specific cause of the outbreak at the Range Livestock Station is not known. The affected animals have been confined and given a ration of soft feeds and plenty of good water. -- NRM Forest and Range Experiment Station release.

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MISSOULA, MONTANA

Volume II, Number 12 November 1, 1950

Snow damage severe. Severe snow-wind damage occurred in timber stands in the Northern Rocky Mountains during the winter of 1948-1949. Data collected in an 80-year-old mixed stand of western white pine, grand fir, and western hemlock on the Deception Creek Experimental Forest give some measure of the severity of the damage. In this stand, 21 percent of the trees were killed. About one-third of the fatalities were caused by uprooting and two-thirds by breakage of the bole. A two-acre permanent yield plot which was established in this stand in 1923 and remeasured at five-year intervals furnished some interesting information on the seriousness of damage. The basal area loss on this plot was 33 percent and the cubic foot volume loss 30 percent. This was a setback of about 20 years in cubic volume and an even longer period in basal area. In fact, the basal area on the plot, after the damage, was less than at the time of establishment of the plot in 1923. Before the damage occurred, stocking on this plot was 88 percent of normal; after the damage, stocking was only 58 percent of normal. These figures not only show how greatly the damage has reduced growing stock, but also point up the seriousness of such upset mortality on yield predictions.

Research on pole blight continues. The cause of pole blight, the new disease of pole-sized western white pine, is not yet known but research is being pressed by several agencies. The School of Forestry of the University of Idaho, and the Division of Forest Pathology, BPISAE, of the U. S. Department of Agriculture, are carrying the brunt of the job. However, the Station also is engaged in research on the disease.

Personnel of the University of Idaho have dissected over 50 trees in detail, from which they have developed a mathematic rating of symptoms. They have established several plots throughout the known range of pole blight to study the rate of progress of the disease and to follow chronology of the various symptoms. They have made a number of patch-grafts and inoculations using various fungi. A major effort of the University has been a study of soils in relation to pole blight. They have also established fertilizer plots and one set of cutting plots.

Pathologists of the Division of Forest Pathology have centered their efforts mainly on inoculations to test various fungi, on tests of fertilizers, and on surveys to determine the extent and severity of the disease. They have carried out an aerial scouting program on the Clearwater, St. Joe, Coeur d'Alene, Kaniksu, and part of the Cabinet Forests. This scouting program has picked up many new locations of pole blight, especially in the St. Joe and Kaniksu areas.

Prepared in the Division of Forest Management Research

The Station has been concerned mainly with the relation of management practices to the disease. A series of plots to test the effect of cutting and poisoning on the disease has been established. However, the cutting and poisoning treatments have not yet been completed.

The three agencies cooperated during the last year in the preparation and distribution of an information booklet titled, "Pole Blight, How to Recognize it."

Pole blight has also been found widely in British Columbia. Pathologists there, too, are studying the disease.

Response of western Montana ponderosa pine to logging release in relation to Keen tree classes. As a by-product from a study of growth of residual ponderosa pine trees in western Montana cut-over stands, a table has been developed which indicates the relationship between Keen tree classification and growth.

D.B.H. growth for 10-year period before logging and after logging 1/

Age class		Vigor class A	Vigor class B	Vigor class C	Vigor class D	Unweighted average
		Inches	Inches	Inches	Inches	Inches
1	(Pre-logging	1.60	1.25	.81	.64	1.08
	(Post-logging	1.99	1.65	1.09	.97	1.42
2	(Pre-logging	1.35	.99	.69	.56	.90
	(Post-logging	1.91	1.26	1.11	.70	1.24
3	(Pre-logging	.97	.74	.54	.44	.67
	(Post-logging	1.38	1.14	.90	.69	1.03
4	(Pre-logging	.72 2/	.60	.42	.38	.53
	(Post-logging	.88 2/	.70	.46	.35	.60
Unweighted average	(Pre-logging	1.16	.90	.62	.50	.80
	(Post-logging	1.54	1.19	.89	.68	1.07

1/ Basis: 926 sample trees.
2/ No 4A trees were obtained in the sample. Values shown for this class were obtained by extrapolation.

# # # # #

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NORTHERN ROCKY MOUNTAIN FOREST
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MISSOULA, MONTANA

Volume II, Number 13 November 15, 1950

A Mistake and A Warning: Volume II, number 11 of Research Hi-Lites prepared by the Division of Range Research and released under date of October 15, 1950, carried an item entitled "Another Cattle Disease" and which concerned Mycotic stomatitis.

Our spelling of Mycotic was erroneous. It has an "o" not an "a"! Also we have been warned that someone might become alarmed by our use of the common name "simple foot-and-mouth disease." As previously pointed out the disease results from eating forage or feed containing irritant fungi - or molds. It is not infectious or contagious and is unrelated to true foot-and-mouth disease. A complete description of the disease may be found in "Special Report on Diseases of Cattle," revised edition, 1942. USDA. -- NRM F&R Experiment Station release.

Range Livestock Prices, Then and Now: Undoubtedly many of us, but particularly those who purchase livestock products at the retail level and rarely if ever are sellers of livestock, wonder how present prices compare with previous market levels. According to the Montana Federal Agricultural Statistical Service the prices received by Montana stockmen and farmers for range livestock in October this year were roughly three to four times greater than the 1909-1914 level and two and a half to three times greater than average 1937-1941 prices. The following table summarizes these comparative prices for several kinds and classes of livestock.

Commodity	Unit	5-Yr. Average August 1909-July 1914	October Average 1937-1941	October 15 1950
Beef cattle	Cwt.	$5.78	$7.36	$24.00
Veal calves	"	7.97	8.68	29.10
Sheep	"	4.97	4.87	13.40
Lambs	"	6.27	7.96	24.40

-- From Montana Federal Agricultural Statistical Service release November 3, 1950.

Fall Seeding In Stubble: Numerous tests conducted by the Northern Rocky Mountain Forest and Range Experiment Station have shown that grasses and other forage plants adapted for reseeding in Montana have a better chance for success if fall seeded in new grain stubble. The stubble provides a firm seedbed and helps catch the snow which protects any seed that germinate before spring and provides favorable moisture conditions for early growth. This enables the seedlings to get an early start

and thus compete more successfully with spring weeds. In addition this method has the obvious advantage of being relatively economical. -- NRM F&R Experiment Station release.

Western Montana Stockmen To Fight Goatweed: At a recent meeting in Thompson Falls, Sanders County stockmen, agency representatives, and other interested persons organized to initiate and support a program designed to stop the infestation of native ranges by goatweed and to provide more research on control methods. Fact-finding committees were appointed to determine the extent and degree of present infestations in western Montana, the probable cost of control and additional research in ecology of the plant and methods of control and to enlist the interest and support of others. The goal is to obtain State and Federal assistance in controlling this noxious range plant on heavily infested areas in western Montana, in eradicating it on recently infested areas anywhere in Montana, and preventing it from infesting Montana ranges now free of goatweed. -- NRM F&R Experiment Station release.

Recovery of Range Grasses from Drought: During the great drought of the thirties northern Great Plains range grasses suffered great reductions in density. In conservatively stocked experimental cattle pastures near Miles City, Montana, the density of perennial grasses on chart quadrats dropped from 28 percent in 1933 to about 2 percent in 1937. The predrought total density level was not regained, even with very favorable weather and conservative stocking, until 1944. Some species recovered more rapidly than others. For example, needleandthread grass was up to its 1933 density level on the plots by 1941 and buffalograss reached its former density in 1942. The two most important species, bluestem wheatgrass and blue grama, were still only 64 and 85 percent as dense, respectively, in 1945 as in 1933. By that year buffalograss occupied 50 percent more surface area on the plots than it did in 1933. Such differences in the rate of recovery from drought of range forage species may well explain some of the changes in vegetative composition which are frequently observed. -- NRM F&R Experiment Station release.

Ecology of the Grassland: Of special interest to students and managers of grassland is a paper entitled "Ecology of the Grassland, II," by Dr. Herbert C. Hanson, published in the June 1950 issue of the Botanical Review. The article is 77 pages in length and contains 304 references, with special emphasis on recent literature. New data relating to fundamental ecological concepts are integrated, and new or refinements of methods are discussed along with a wealth of other material. Much of the material is of direct value to range managers. The author who has spent most of his life doing ecological research and teaching in western States is now at The Catholic University of America, Washington, D. C. -- NRM F&R Experiment Station release.

Native Browse Species Have Low Germination: Seed germination in ten native species of browse proved to be very low in a recent study conducted by the Montana Fish and Game Department. Only 15.1 percent of the seed germinated on the average in fresh ashes, the best of four seedbeds tested. Average germination under slash, on scarified ground and on natural surfaces averaged about 12 percent. Chokecherry had the highest, 44.2 percent, and Kinnikinnick the lowest, zero percent, germination on the burned area. Dogwood, Serviceberry, mountain maple, and bitterbrush germinated from about 22 to 26 percent in ashes. Survival of seedlings during the past summer was generally good. -- From Quarterly Progress Report, Wildlife Restoration Division, Montana Fish and Game Commission, vol. 10, no. 3, July, August, and September 1950.

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NORTHERN ROCKY MOUNTAIN FOREST
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MISSOULA, MONTANA

Volume II, Number 14 December 1, 1950

Some Tips on Using Aerial Photos

Inking type lines: Foresters have long sought a convenient and efficient device for drawing clear and permanent type lines on aerial photographs. Field men on the Forest Survey have tried different pencils and pens with varying degrees of success. The Ink-O-Graph fountain pen, using Weber's waterproof pigment, drawing ink has proved the most satisfactory to date. A self-cleaning feature operated by shaking the pen restores ink flow when clogged from intermittent use. Line width can be varied by sanding the point. The pen costs about $2. Weber's ink gave the best results of the inks tried. Black is recommended for type lines. Other colors are available. Corrections are easily made before the ink sets by wiping off lines with a damp cloth. Under normal use the inked lines will not smear or chip.

Matching type lines on adjacent photos: Delineating types on pictures involves much jibing between overlapping prints. In the field this job is facilitated by lightly cutting through the emulsion and folding the photo. Cuts are made along the edge of the effective area or on section lines where corners are used for control. When typing is completed on one photo the lines are easily extended across the cut to the adjacent photo without using a stereoscope. Distortion can be "side stepped" at the cut by matching tones and checking on topographic features. This procedure assures good matching when the photos are fitted into a mosaic and virtually eliminates mapping the same area on two pictures.

Per-Capita Income in Northeast Washington Has Wide Range: A recent analysis of per-capita income in the six Northeast Washington counties showed Lincoln County residents had an average income in 1948 of $2986, while in Ferry County the income was only $892. In 1948 six counties, Ferry, Lincoln, Pend Oreille, Spokane, Stevens, and Whitman, received 13.4 percent of the State's total income, but include 19 percent of the State's area.

Within the six-county unit one of the striking relationships is how much lower the per-capita income was in the more heavily forested counties. The three northern counties, Ferry, Pend Oreille, and Stevens, have 79 percent of their area classed as commercial forest land and the three

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Prepared by the Division of Forest Economics

southern counties, Lincoln, Spokane, and Whitman, 14 percent of their area thus classified. The per-capita income of the northern group averaged $941, while in the southern group it was $1835.

The disparity between the northern and southern group has increased since 1939. In the southern group income increased 198 percent from 1939 to 1948, while in the northern group income went up only 104 percent. The county data do not disclose source of income so it is not possible to determine what part of the total income in each group is attributable to the forest resource. It is clearly evident, however, that the higher income in the southern counties is from agriculture.

1949 Lumber Production in Northern Rocky Mountain Region Estimated at 1.6 Billion Board Feet: Although no census of lumber production was made in the Northern Rocky Mountain Region in 1949 estimates have been prepared from available source material. Using production records from 36 identical sawmills which accounted for 55 percent of the regional lumber output in 1948 and adjusting for changes in a few of the large mills, 1949 lumber production for Montana, North Idaho, and Northeast Washington is estimated as follows:

Estimated Lumber Production. 1948-1949
Northern Rocky Mountain Region

Year	Montana	North Idaho	Northeast Washington	Total
	Million feet, board measure			
1948	598	786	269	1,653
1949	576	795	241	1,612
Percent change	-3.7	+1.1	-10.4	-2.5

"Marketing Montana Christmas Trees" is the title of a bulletin prepared in the Division of Forest Economics and published by the Montana State University. The bulletin discusses the factors related to marketing Christmas trees, including waste of trees, the distribution system, price trends, freight costs, foliage blight, and quality trends. A suggested program for improving the marketing of Montana Christmas trees included the adoption of tree quality grades, developing consumer preference, and fostering grower associations.

GEORGE M. JEMISON, Director, NRM Forest & Range Exp. Station

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United States Department of Agriculture
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NORTHERN ROCKY MOUNTAIN FOREST
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MISSOULA, MONTANA

Volume II, Number 15 December 15, 1950

Prepared in the Division of Range Research

Special Announcement: Northwesterners interested in rangelands, their uses, and problems and in allied fields have a unique opportunity for an informative session and for meeting old and new friends of common interest at the fourth annual meeting of the American Society of Range Management in Billings, Montana, January 23 through 26, 1951.

This applies to everyone interested in range - stockmen, range men, and others who recognize the close tie between their economy and that of the western livestock industry.

Membership in the Society is open to persons "who are interested in or engaged in practicing range or pasture management or animal husbandry; administering grazing lands; or teaching, or conducting research, or engaged in extension activities in range or pasture management or related subjects." And, "Applications for membership may be made at any time and applicants will be considered elected to membership upon payment of current dues." So for those who have intended joining the Society but have never gotten around to it and to those who may be hearing about the Society for the first time, the Billings meeting will be a fine start.

The tentative program of the meeting as published in the October issue of the Journal of Range Management and quoted below portends a worth-while session:

First Day: Forenoon - Greeting by the Governor of Montana; President Savage's address, and business session. Afternoon. -- Special range problems of the Northern Rocky Mountain and Great Plains Regions.

Second Day: Forenoon - Big game problems of range lands. Afternoon - Range management in western Canada. Evening - banquet.

Third Day: Forenoon - Recent significant developments in management and research. Afternoon - How to obtain faster progress in range management on the ground.

Fourth Day: Weather permitting - a trip to the Miles City range and livestock experimental areas.

So, in words of the Journal: "Be sure to leave some of your vacation time until then, arrange with a neighbor to do your chores, and take your wife along to enjoy the activities planned for the ladies." -- NRM F&R Experiment Station release.

Calf Weights Reflect Range Stocking: Birth and weaning weights of first calves from a new herd of experimental cows used in grazing intensity studies at the United States Range Livestock Experiment Station near Miles City, show a definite spread between stocking intensities. The grazing studies, started in 1932, have entailed the use of two other herds of breeding cows. Both of these earlier herds went into the experiment as bred 2-year-old heifers. The present herd is unique, however, in that individual pasture groups were put into the experiment as yearlings and have been carried on heavily, moderately, and lightly stocked range since that time. The three rates of stocking provide 23.1, 30.5, and 38.8 acres of range per cow yearlong. As yearlings and 2-year-olds the cattle were provided 0.6 and 0.75, respectively, of these range acreages.

Rate of stocking is already affecting the weights of calves from these 3-year-old cows. Birth weights, summarized below, show that on the average first calves from cows on lightly and moderately stocked range outweighed calves from cows of equal age and breeding on heavily stocked range by 7.1 and 3.4 pounds, respectively. Heifer and bull groups followed the same pattern except that the heifers under moderate stocking averaged the lighest, by one pound, of the heifer groups. Bull calves averaged heavier than heifer calves except under heavy stocking where a 42 pound bull calf pulled down the average weight for the group. The spread in calf birth weights under heavy stocking was from 42 to 74 pounds, under moderate from 48 to 87 pounds, and under light from 58 to 82 pounds.

1950 Calf Birth Weights

	Heavy			Moderate			Light		
	Bulls	Heifers	All calves	Bulls	Heifers	All calves	Bulls	Heifers	All calves
No. of calves	7	11	18	7	11	18	6	11	17
Total weight (lbs.)	423	732	1155	496	721	1217	438	774	1212
Av. weight (lbs.)	60.4	66.5	64.2	70.9	65.5	67.6	73.0	70.4	71.3

By weaning time, October 16, the calves from lightly and moderately stocked ranges outweighed the calves from heavily stocked range by 51.7 and 37.1 pounds, respectively. Average weight differences were 24.9 and 9.9 pounds in the heifer groups and 89.9 and 74.0 pounds in the steer groups. Under heavy stocking heifers outweighed the steers but the reverse was true in the other intensity groups.

1950 Calf Weaning Weights

	Heavy			Moderate			Light		
	Steers	Heifers	All calves	Steers	Heifers	All calves	Steers	Heifers	All calves
No. of calves	7	9	16	7	11	18	6	11	17
Total wt. (lbs.)	2192	3234	5426	2710	4062	6772	2418	4226	6644
Av. weight(lbs.)	313.1	359.3	339.1	387.1	369.2	376.2	403.0	384.2	390.8

The range in weaning weights was from 210 to 424 pounds under heavy stocking; 238 to 496 pounds under moderate, and 340 to 440 pounds under light stocking.

Granting that small numbers are involved and that only one crop of calves is reported, the data show a strong tendency toward bigger calves at birth and weaning from cows run since yearlings on moderately and lightly stocked range. -- NRM F&R Experiment Station release.

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Volume III Number 1 January 1, 1951

SAWDUST SHOULD GO BACK TO THE SOIL

Almost one-half million tons. That's the size of the sawdust pile made every year by sawmills of the Northern Rocky Mountain area. Much of it is burned - a waste of precious and badly needed organic material.

Ranger McDonald of the Bitterroot National Forest pondered this problem and came up with a good solution. He was much concerned over Soil Conservation Service statements that many of our soils are now starving for humus - that we must rebuild and conserve them for posterity. In his own Bitterroot Valley of Montana, some irrigated soils were becoming compacted and difficult to till after 75 years of farming. Searching the pages of scientific literature furnished by the Forest Utilization Service he found that,(1) aged or old sawdust is a good soil conditioner, (2) new sawdust can also be used as a soil conditioner and fertilizer if a nitrogen supplement is added, and (3) new sawdust used in the feedlot and there impregnated with manure and urine makes a good soil conditioner and fertilizer.

Next, Ranger Mac sold these facts to some of his neighbor ranchers. Several of them tried sawdust as a soil conditioner. One, Joe Canton, used 40-year-old sawdust on a sugar beet field. The test acreage was treated with approximately 20 tons per acre of 40-year-old softwood (pine, fir and larch) sawdust.1/ An adjacent check area was given the customary treatment of 10 or 12 tons of barnyard manure per acre. A plentiful supply of water was available throughout the growing season for surface irrigation of both areas. Joe reported beets on the sawdust treated area grew better from the start and soil retained moisture longer after each irrigation. There was also evidence that the sawdust treated plots had substantially higher yields per acre and beets analyzed by the American Crystal Sugar Company were slightly higher in sugar content and purity. However, one such test as this is not conclusive, but it does bear out the conclusions of previous experience and research on the subject.

The American Crystal Sugar Company became interested. They are constantly seeking ways of improving the tilth and yield of western Montana beet lands. Large scale trials using planer shavings are now under way on acreage adjacent to the sugar plant at Missoula. During the 1950 season 6 acres were treated with 20 tons per acre

1/ Analysis indicated that cellulose had deteriorated to about one-half the content of new sawdust.

Prepared by the Forest Utilization Service

of planer shavings impregnated with sheep manure at a nearby sheep feedlot. Even though sheep manure is high in nitrogen an additional nitrogen supplement was added. Four hundred pounds per acre of ammonium sulphate was plowed under with the woody manure, and 100 pounds per acre of ammonium nitrate side dressing was added during the growing season. Frank Cleland, Manager of the Sugar Company, cautions against the use of sawdust or shavings without a nitrogen supplement. Results of the 1950 experiment showed the ground treated with wood manure improved materially in tilth and in moisture holding capacity.

When Ranger Mac set out to locate sawdust for these experiments only new sawdust was plentiful. Old or aged sawdust was hard to find because Montana law requires operators of small sawmills to burn sawdust piles. During the past 75 years millions of tons of good humus have gone up in smoke. Now ranchers wonder why sawdust that can't be used currently shouldn't be stored for future use as a soil conditioner.

Use of sawdust as a conditioner for irrigated soils is one solution to the sawdust disposal problem of western United States. Such use is not new. Our European forefathers used it. Thrifty New England farmers have used it for years. The attached mimeograph by A. C. McIntyre of the Soil Conservation Service tells why the farmer can't go wrong in using sawdust as a soil conditioner.

Attachment

GEORGE M. JEMISON, DIRECTOR

I. V. ANDERSON, Chief, Forest Utilization Service

L. A. MUELLER, Asst. Chief, Forest Utilization Service

It is well accepted that the most important factor in good soil husbandry is the maintaining or increasing of humic content. Good farm management recognizes the need for adequate crop rotation, applications of animal manures and the use of mulch, all objectively programmed so that optimum levels of humus, which will give to the residue we call soil, both physical and chemical life as reflected by acceptable harvests.

There are two forms of humus. Nutrient or readily decomposable humus and long-life or resistant humus. Nutrient humus is derived from high cellulose plant tissues such as green manure crops. This form of organic matter is easily broken down, usually lasts but a few summer weeks or months, and principally serves micro-organisms as a source of carbon. It is not the type of humus that builds up desirable physical properties in the soil. Long-life humus, as the name implies, represents the humus capital of soils. (1) It is with this form of humus we are principally concerned and to which wood can make the greatest contribution.

There have been a number of comprehensive studies on the use of wood as a soil amendment. They have shown that sawdust will produce beneficial effects when mixed with any soil, providing the nitrogen supply is adequate or is supplemented with sufficient nitrogen to offset the probable depressive effect of the sawdust. (27) All research in the use of sawdust established the need for adding a high nitrogen fertilizer such as $(NH_4)_2SO_4$ and at the rate of about 60 pounds per ton of dry matter. This nitrogen requirement applies, however, whenever most organic materials are mixed with soil, because the organisms responsible for decomposition require nitrogen for food in making protein for their own bodies.

The bacteria and fungi use the readily available forms of nitrogen, particularly nitrates, and thus compete directly with the higher plants. Later, after the bacterial activities subside, the protein nitrogen in the bacterial cells is converted to nitrates. Thus, while the immediate result of the addition of large amounts of carbonaceous material to the soil is harmful, the ultimate effect is beneficial. It has been found that wood in the form of shavings or sawdust reacted in the same way as mature hay when used as a conveyor of animal manures. (16)

The mixing of wood with soil has been determined to have no toxic effects on plants due to such wood constituents as essential oils, resins and tannine. (26) (28)

Certain woods decompose more readily than others, hence more nitrogen is "grabbed" by the organisms. This nitrogen "grab" is more pronounced with sawdust than with chunk wood. This is to be expected because the rate of decomposition is related to the exposed surface of the organic substance. A large wood chip would decompose more slowly, hence the amount of nitrogen used at one time, or necessary to apply, would be considerably less than for small wood fragments such as wood flour or sawdust. The nitrogen used is not lost to the growing plants but temporarily withheld until decomposition requirements are satisfied. Studies on this subject established the fact that "the lack of nitrate (for the growing plant) is due to a reduction rather than to an inhibition of nitrification and that this reduction is caused by a group of organisms which make use of cellulose. With large amounts of blood meal in the soil the rate of nitrification could be so increased that it exceeded the rate of

reduction, resulting in an accumulation of nitrogen. Furthermore, the nitrogen starvation soon passes off and is almost without effect the following season.(28)

Results from incorporating two inches of sawdust with soil on yield of tomatoes have been reported. (12) It was found that yields were less for the first crop and higher for the remaining crops than yields on the check plots which received equivalent applications of nitrogen. When 120 pounds of nitrogen per acre were used, yields were greater the first year and each year thereafter than was produced on the check plots receiving 60 pounds of nitrogen. This would indicate that the nitrogen requirement was satisfied. Nitrates were depressed the first eighteen months after which time they began to accumulate, the moisture level in the soil was increased, a softer crust was formed and a looser soil resulted. The mixing of sawdust or shavings into a soil, especially heavy soils, materially improves its physical properties. The capacity of the soil to take in and hold water is improved. In the spring, sawdust at the rate of $7\frac{1}{2}$ tons per acre was plowed into a nursery soil. In the fall, laboratory tests on random samples showed that for the sawdust blocks, water-stability was 70% as contrasted to about 16% for the non-treated blocks. The crops of black locust seedlings and sudan grass on the sawdust block were comparable to the check blocks. When the blocks were fall plowed the workmen reported marked difference, with the soil on the sawdust block turning easily and having excellent structure.

Adding organic material to a light (sandy) soil gives it "body" and the ability to retain moisture. Because wood chips will not decompose as rapidly as sawdust it can be assumed that their use would be preferred because of longer lasting beneficial results.

Humus is high in lignin. It is referred to as a ligno-proteinate. Studies in the use of lignin on soils have shown that it imparts desirable physical characteristics. (23) Heavy soils with little humus in them and low water intake capacity were so improved by incorporating lignin in them that infiltration rates were increased to the point where heavy rains did not produce a ponding effect, as contrasted to non-treated check plots. (2)

Lignin tends to accumulate in the soil. Thus the incorporation in the soil of plant tissue high in lignin will tend to build up long-life humus. Lignin of fresh plant tissues may be partly decomposed by the action of higher fungi but once the lignin becomes isolated it becomes resistant to attack even by these organisms. Lignin of younger plants seems to be more readily attacked by micro-organisms than in older plants. Therefore, due to its high resistance to attack by micro-organisms, the amount of lignin in the soil increases while the amount of cellulose, pectin, etc., decreases and finally disappears. This is the process of humus formation. (8)

The "Old Wives' Tale" that wood sawdust produces excessive soil acidity has little merit. (18) Softwood sawdust contains less basic material than hardwood sawdust or most strawy materials. Upon decay, most of the organic acids are used by organisms or lost into the air leaving a neutral or alkaline residue. It should be remembered that plant ashes are alkaline. Sawdust from certain tree species contain large amounts of tannins and terpenes, but even these seldom remain in soils very long because soil organisms rapidly destroy them.

WOOD FOR ANIMAL BEDDING

Sawdust and shavings have been found to make excellent bedding materials. The requisites of a good bedding are its capacity to hold liquids and its ability to provide clean, comfortable quarters.

Sawdust and shavings have been found to hold from two to four times their own weight of liquids, which is equal to the absorptive capacity of any other of the common bedding materials. A cord of coarse sawdust will absorb two thousand pounds of liquid manure.

Farmers who use sawdust or shavings for bedding like them because they not only keep the barn clean but are easy to handle. Woody manures are readily worked into the soil. When applied to grass land they promptly sift through to the soil, which is a highly desirable characteristic.

At the Rhode Island Agricultural Experiment Station straw bedding was compared with sawdust or shaving bedding manure over a period of 18 years in a three crop rotation. From this long time experiment it was concluded that there were no detrimental effects to the land from the use of shavings or sawdust bedding as compared with straw. Crop yields were about the same. Of particular interest was the fact that there was no appreciable difference in soil acidity. Other stations report comparable results. (8)

It is known that when large amounts of any bedding are used, in comparison to the animal manure, crop yields may be reduced unless a nitrogen fertilizer is used. This is because insufficient amounts of nitrogen are added to the bedding by the manure to adequately provide for the growth of the soil micro-organisms which cause decay or rotting of the added materials and they then draw upon the available nitrogen in the soil, thus depriving growing plants of this essential element.

Harmful effects can be eliminated by using lesser amounts of bedding (not a good thing to do), or by adding necessary amounts of a nitrogen fertilizer to the manure. Fifty pounds of ammonium nitrate or seventy-five pounds of ammonium sulphate per ton of bedding material will meet the nitrogen needs. As much as twenty tons of woody manure can safely be applied per acre year if nitrogen requirements are satisfied.

Wood chips can be used for bedding. It is the size or shape of the chip that is important. Sawdust and shavings are really chips and are produced by stripping chunk wood with a sharp instrument. Wood chips, the size of coarse sawdust, can be produced in volume, at a low cost, by means of a portable wood chipper.

Portable chippers can be readily trailed behind a jeep or pick-up. They can move into the farm woodlot and there moved from pile to pile of pole or limb wood to produce a bedding material equal to that of straw. The cost of wood chip bedding should be less than one-third that of straw.

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume III, Number 2 January 15, 1951

Prepared in the Division of Range Research

Halogeton in Montana: A recent report that Halogeton, an extremely poisonous range plant, had appeared on ranges in one or more southwestern Montana counties seems to be unfounded. Reliable sources report that to date in Montana Halogeton has been found only in that section of Carbon County which is south and east of Bridger and directly south of the Pryor Mountains. This occurrence is on the northern fringe of an extensive infestation which extends from the Big Horn river westward to the Clark's Fork drainage in northern Wyoming. — NRM F&R Experiment Station release.

Experimental Cows Do Well On Winter Range: Since their calves were weaned on October 23, three-year-old breeding cows in grazing intensity experiments at the United States Range Livestock Experiment Station near Miles City have gained considerable weight in spite of a good deal of snow and cold weather. Cows on heavily stocked range went into the winter weighing 912 pounds on the average, or 77 and 126 pounds lighter, respectively, than cows of the same age on moderate and lightly stocked range. By the end of December the cows on heavily stocked range had gained 59 pounds per head on the average or 6.5 percent of their October 23 weight. Under moderate and light stocking the average gain per head has been 38 and 39 pounds or 3.8 and 3.7 percent, respectively, of the October 23 weight. Even though cows on heavily stocked range benefited more by weaning and transfer to fresh winter range they are still 57 and 106 pounds lighter on the average than cows on moderately and lightly stocked range. No supplemental feed had been given any of the experimental lots by the end of December. With the winter rapidly approaching the half-way mark, prospects are good for satisfactory wintering of the experimental cattle until grass grows green again. — NRM F&R Experiment Station release.

Forage grasses, spring seeded in 1949 produced more than twice as much herbage per plot on the average, than the same species planted under similar conditions on the same site in the late fall of 1948. These results were obtained from clipped samples taken at the end of the second growing season on a semiarid forage nursery site near Republic, Washington. Another planting of these species in the spring of 1950 at the same nursery also appeared to have produced more herbage than a similar planting made in the fall of 1949, although clipped samples were not taken on these two plantings. Even though spring seeding seemed to have advantages in these trials further tests are needed to establish the best season for planting.

Ten of the 25 species and strains tested in this trial were outstanding in herbage production. They are in descending order from the highest producing species; pubescent wheatgrass, standard crested wheatgrass, intermediate wheatgrass, Manchar smooth bromegrass, orchardgrass, fairway crested wheatgrass, Russian wildrye, Whitmar beardless bluebunch wheatgrass, tall wheatgrass, and alta fescue.

Both mountain bromegrass and slender wheatgrass produced yields comparable to pubescent wheatgrass, but were not included in the above species comparisons because they have generally proven too short-lived for range plantings. -- NRM F&R Experiment Station release.

Interest in Range Research Increases: Something of a record for visitors interested in range research has been set at the United States Range Livestock Experiment Station near Miles City during the past 3 years. In 1948 two hundred visitors came in organized groups. In 1949 the number increased to 12 groups and 302 persons and in 1950 fifteen groups containing 512 persons came to see the range studies. For the period of nearly 3 years the total is over a thousand visitors in 30-odd groups. This number, which does not include individual or casual visitors, constitutes over 90 percent of all visitors to the station. It is highly significant that such a high percentage of the station's visitors showed an interest in range research in view of the fact that the station is primarily devoted to beef cattle research by the Bureau of Animal Industry.

In 1950 the visitors came from all the western range states, except California, and from Canada. Aside from private interests they represented 6 federal agencies and several departments in at least 2 state agricultural experiment stations. Numerous vocational agriculture and high school groups were included. Group size usually ranged from 9 to 30 persons but one group of 80 and another of 85 were received. In addition range personnel have addressed numerous groups away from the station.

This three-year trend and the present heavy visitor load at Miles City definitely indicates increased interest in the range work conducted at the station, and recognition of research in that field. -- NRM F&R Experiment Station release.

More About Pellet Seeding: A report on seedling stands obtained from both airplane and ground seeding of pelleted and loose seed of forage plants has just been released by the Intermountain Forest and Range Experiment Station.

This study involving four vegetation types, 7 forage species, ground and airplane seeding methods on an area of 8,000 acres showed that unpelleted or loose seed produced from about 15 to 165 times more grass seedlings than pelleted seed. With one exception, all stands from loose seed were rated "medium" to "very good" while all stands from pelleted seed were rated "very poor."

Total costs per acre were, $2.40 for seeding 1 pellet per square foot, $4.80 for seeding 2 pellets per square foot, and $3.47 for loose seed broadcast at 10 pounds per acre.

Laboratory tests on 7 species showed that germination was depressed by pelleting. Germination ranged from 11 to 78 percent for pelleted seed and from 62 to 98 percent for loose seed. Plant emergence on nursery plots ranged up to 42 percent for pelleted seed but for loose seed it varied from 18 to 84 percent of the seed planted. Seed washed from pellets had slightly higher germination and emergence percentages than did pelleted seed. In conclusion the report emphasizes the fact that pelleting seriously reduced seed germination and seedling emergence. Doubling the standard seeding rate of pellets did not materially improve the seedling stand. -- Research Paper #22, "Seedling Stands from Airplane Broadcasting of Pelleted and Unpelleted Seed in Southeastern Utah," Intermountain F&R Experiment Station.

REMEMBER THE A.S.R.M. CONVENTION, BILLINGS, MONTANA, JANUARY 23-26. INCLUDED IS A TRIP TO THE UNITED STATES RANGE LIVESTOCK EXPERIMENT STATION, MILES CITY, ON THE 26TH.

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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume III, Number 3 February 1, 1951

Prepared in the Division of Fire Research

Big Fires Are a Big Problem. In a recently completed study of 36,000 forest fires a special analysis was made of big fires. We defined a big fire as any fire reaching a final size of 300 acres or more. These are referred to as Class E fires in official firefighting language. Less than 1 percent of the fires on the national forests reach Class E size. However, this very small number of fires accounts for over 90 percent of the total area burned. During the 15-year period 1931-1945 a total of 208 Class E fires burned 775,814 acres. The region averages 14 big fires annually, but in years of high fire danger three times this number may occur. Large numbers of big fires have occurred in every critically dry season in the history of organized fire protection.

Why do forest fires get big? There are a multitude of reasons, but two factors causing big fires stand out above all others -- tough fuels and high burning index. Big fires don't just "happen." Barring major mistakes by the suppression forces, fuels and burning index provide the best guides to big fire probabilities. Six times as many Class E fires occur per million acres in extreme rate-of-spread fuels as in low rate of spread. Resistance-to-control classification is an even more important indicator. Extreme resistance-to-control fuels are 12 times as bad as low resistance in breeding Class E fires. Big fire occurrence increases as burning index increases. Nearly 9 times as many fires reach Class E size at a burning index of 80 as at 40.

Big fires are costly in resource damage, firefighting dollars, and man-days. The region averages 51,720 acres burned annually in Class E fires. These fires account for damage to over 450,000,000 board feet of timber per year -- more timber than is harvested in cutting operations. An average of 30,678 man-hours is spent in suppression per fire. At present-day firefighting costs this amounts to $77,000 per fire, or over a million dollars annually. The output per man-hour is low on large fires. Studies of 100 fires involving multiple crew action showed that the output of held line is only 0.08 chains per man-hour, less than 6 feet of held line per man-hour. Mop-up costs also are high. An average of 15,174 man-hours per fire, or 49.5 percent of the total suppression man-hours, is devoted to mop-up on big fires.

Ten Years of Low Fire Danger. In the future firefighters in this region will look back gratefully to the 10-year period 1941-1950 -- a decade of phenomenally low fire danger. An analysis of fire danger measurements made on 10 national forests lying west of the Continental Divide during the period 1934-1950 shows that the easy burning conditions started in 1941. During the 7-year period prior to 1941 one or more national forests had danger ratings in the "critical" class in every year except 1938. Furthermore, during this period there were a total of 31 "critical" ratings and not a single "easy" rating. During the 1941-1950 period not a single "critical" rating was recorded, and there were 31 "easy" ratings.

The system of annual ratings of fire seasons was developed by H. T. Gisborne. It is based upon a statistical analysis of the July-August danger ratings for 10 western forests which shows that 99 percent of these ratings can be expected to fall between a maximum of 76 and a minimum of 21. All ratings are obtained from the NRM fire danger meter. A rating of 76 is considered 100 percent of worst probable, and a rating of 21 is 0 percent. Three classes of fire seasons are determined from these ratings -- "critical" is 68 percent or more of the worst probable, "average" is 33 to 67 percent of worst probable, and "easy" is 32 percent or less.

The worst fire danger measured to date occurred in 1934 when all western forests had a "critical" rating. Other bad years were 1936 and 1940. The easiest years were 1948 and 1950. In 1948 every western forest had an "easy" rating. The fire season of 1945 was the last period when one or more forests did not have an "easy" rating. Ratings for all western forests for the period 1934-1950 are shown on the attached sheet.

****

GEORGE M. JEMISON, Director

Division of Fire Research Staff

JACK S. BARROWS, Chief
GEORGE R. FAHNESTOCK
EDNA H. CAMPBELL

REGION ONE

WESTERN FORESTS

Percentage of Worst Probable Fire Danger

Statistical analysis of the July-August (62-day average) danger class for each of the 10 western forests (Colville excluded) for the years 1934 through 1948 shows that at least 99% of such averages can be expected to fall between a maximum of class 76.02 and a minimum of class 21.48. These limits are therefore assumed as Worst Probable and Least Probable danger classes. By this scale a forest averaging class 76.02 would be rated as 100% of Worst Probable. If its average were 21.48 it would rate 0%. Class 48.75 rates 50% of Worst Probable.

In the cases listed below percentages of 68% or more are considered critical and are underlined. Percentages of 32% or less are called easy. Intermediate percentages indicate average July-August fire danger.

NATIONAL FOREST	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
	Percentage of Worst Probable																
Bitterroot	71	71	58	73	52	65	76	36	60	51	34	49	32	36	18	45	36
Cabinet	84	61	80	65	65	71	80	46	52	45	34	45	40	36	17	42	29
Clearwater	87	65	63	65	52	58	58	34	43	43	23	34	18	23	12	31	24
Coeur d'Alene	75	61	65	49	61	71	71	40	43	40	29	38	30	23	10	35	27
Colville										52	36	51	36	29	18	49	40
Flathead	93	65	78	71	61	67	67	47	43	52	27	40	25	27	16	35	18
Kaniksu	71	45	67	52	61	75	67	43	45	45	32	47	30	25	12	36	31
Kootenai	78	58	87	61	65	71	71	43	38	45	27	43	29	23	10	24	25
Lolo	85	71	85	71	58	71	78	43	55	52	34	52	38	41	30	56	33
Nezperce	89	80	67	67	52	58	61	34	49	43	34	43	25	38	12	42	35
St. Joe	75	71	61	55	55	67	61	38	45	36	32	36	29	32	16	36	27

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

February 1952

Freshly burned "dog-hair" lodgepole pine stands may be successfully revegetated with several forage species. Tests were conducted in stagnated stands of lodgepole pine, which developed on the 1929 Dollar Mountain burn near Republic, Washington, to discover forage species that would grow on typical sites and to determine the feasibility of broadcasting the seed directly into fresh ashes. Such information is essential for this high fire hazard area where immediate revegetation for watershed protection would be necessary following any recurrence of accidental fire. Trees on two areas located on northeast- and southwest-facing slopes were slashed and the resulting debris was broadcast burned. Eighteen forage species were broadcast planted in the fresh ashes on individual plots of each area. The soils of both areas are of granitic origin. However, weathering of the parent material on the northeast slope is more advanced and the amount of topsoil somewhat greater than on the area with a southwest exposure.

After two growing seasons, several species appear to be well adapted to growing conditions on these sites. Based on plant vigor and stand density, the species appearing in the following summary produced satisfactory stands on one or both areas:

Average stand density, ungrazed leaf height, and vigor class of the most successful forage species on each study area

Species	Northeast exposure			Southwest exposure		
	Plants per sq.ft.	Leaf height (inches)	Vigor	Plants per sq.ft.	Leaf height (inches)	Vigor
Sheep fescue, common	19	5	Ex.	32	4	Good
Big bluegrass	18	9	Ex.	15	8	Good
Timothy	48	3	Good	33	2	Fair
Red top	12	4	Good	25	4	Fair
Orchardgrass, common	11	7	Good	13	4	Fair
Tall oatgrass, Tualatin	8	15	Good	7	9	Good
Alsike clover	13	1	Poor	12	¼*	Good

* Grazed height -- no ungrazed plants found.

Prepared in the Division of Range Research

Generally, the reseeded species were more successful on the area with the northeast exposure, probably because of more favorable moisture conditions. On this area the plants were thriftier and in most cases the stand density greater than on the southwest slope. Common sheep fescue and big bluegrass produced excellent stands on the northeast area; and timothy, red top, orchardgrass, and tall oatgrass produced satisfactory stands on both areas. Alsike clover appeared to be more adaptable to the site exposed to the southwest. Poor stands on both areas were obtained with standard crested, beardless, and stiff-hair wheatgrasses; Manchar smooth brome; tall fescue; green needlegrass; small burnet; Ladak alfalfa; and yellow sweet clover. Intermediate wheatgrass and Russian wild-rye failed completely on the southwest-facing area.

Use by deer and rabbits was more prevalent and included more of the reseeded species on the southwest than on the northeast slope. Alsike clover was the only species used on both areas; and of all the species grazed, it received the heaviest use. In addition, on the southwest-facing area smooth bromegrass, orchardgrass, tall fescue, and red top were grazed by these animals. The apparent species preference of wildlife, as shown on these areas, may be an important consideration in selecting species to reseed such areas that have been accidentally burned.

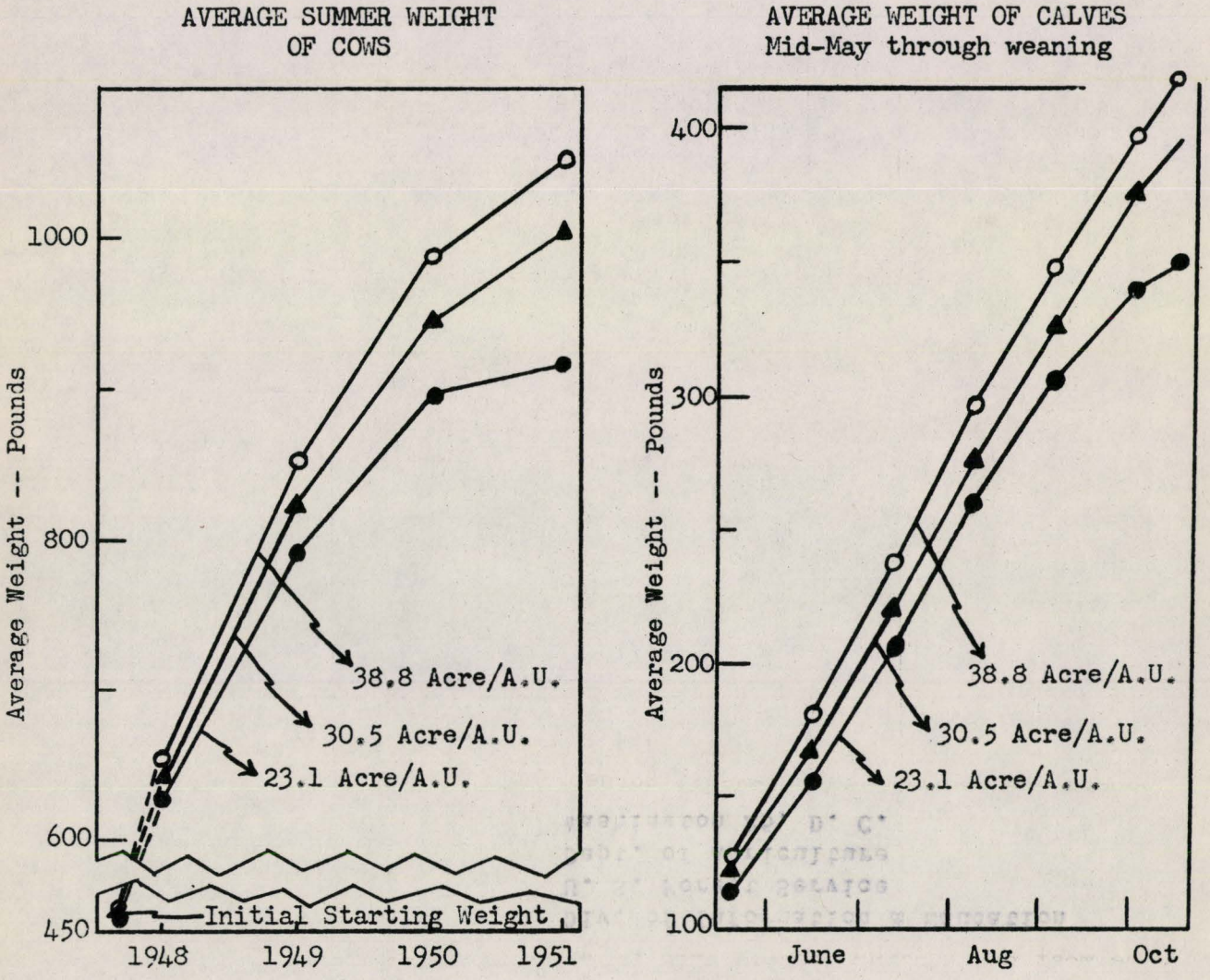
Several forage grasses appear to be well adapted to growing conditions in northeast Washington. Species adaptation tests have been conducted on well-drained sandy-loam soils near Republic since 1948. Spring and fall plantings of about 25 species, strains, and varieties of forage plants were made under similar conditions on the same site in each of 3 years. Periodic ratings of plant vigor and distribution in the stand of the reseeded species were made throughout each growing season. Based on these ratings, spring-planted species that produced excellent stands in each of 3 years were standard and Fairway crested, intermediate, tall, Whitmar beardless, Primar slender, and stiffhair wheatgrasses; tall fescue; Manchar smooth, common, and Bromar mountain brome-grasses; and Aberystwyth orchardgrass. These species also produced good stands when planted in the fall but were somewhat less successful than the spring plantings.

Producing less satisfactory stands and less herbage were bluestem, Siberian, and common slender wheatgrasses; common orchardgrass; sheep fescue; big bluegrass; and Ladak alfalfa. These species were about equally successful in both the spring and fall plantings. A group of species producing unsatisfactory stands of plants in poor vigor in both spring and fall plantings included timothy, Canada and Kentucky bluegrasses, burnet, an improved strain of needleandthread grass, and Ladak and creeping alfalfa. Failing completely in the fall plantings and producing very poor stands when planted in the spring were the superior strain of Reed canary grass, Russian wild-rye, perennial ryegrass, strawberry clover, Ladino white clover, and big trefoil.

The most outstanding species from these tests are to be used in field plantings and grazing trials in the mountainous areas of northeastern Washington.

Cattle weights reflect stocking intensity. Growth of range breeding cows and their spring calves, during 1950 and 1951, clearly reflected the rates of range stocking which the Miles City experimental pastures have been subjected to for more than 15 years. The experimental ranges were stocked in May 1948 with yearling heifers at the established rates of 23.1, 30.5, and 38.8 surface acres per animal unit yearlong. These stocking rates had been in effect

since 1933. The yearling heifers have grown to maturity and produced two crops of calves. Comparative growth of both cows and calves under the three stocking rates, illustrated by the following figure, strongly supports the concept that body size of animals is largely an expression of dietary level. In other words, the growth, as reflected by weight, of cows and calves in this study was correlated with abundance of forage in the pastures stocked at different levels.



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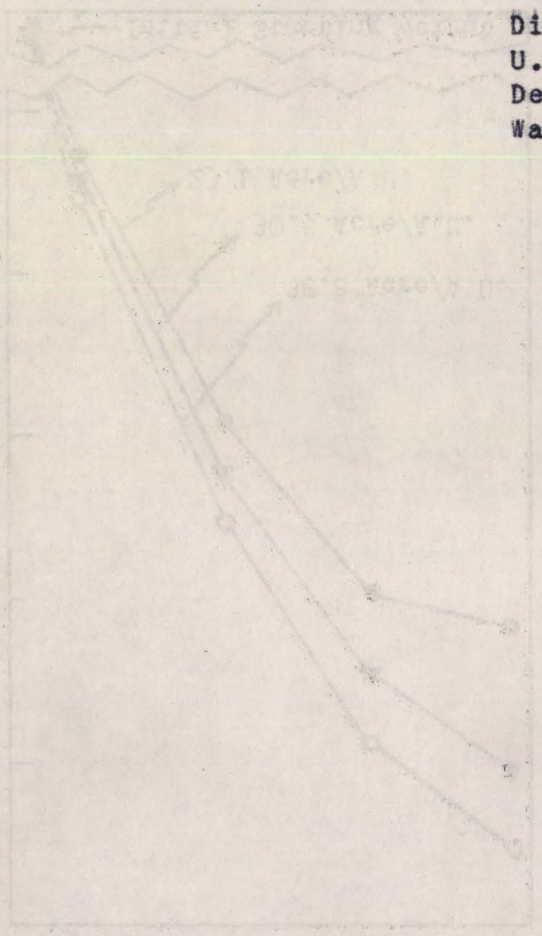

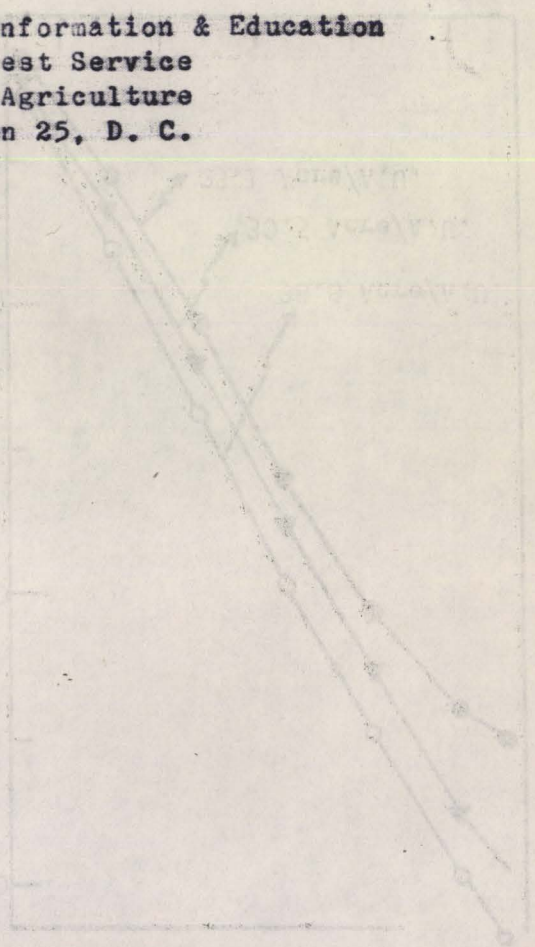

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume III, Number 4 February 15, 1951

Prepared in the Division of Range Research

Belvedere Summercypress - A Useful Weed: All too frequently weeds that flourish abundantly under a changed environment caused by man or nature are a paragon of evil. Something of an exception is Kochia scoparia, an old world immigrant, commonly known as Belvedere summercypress or firespray.

This plant, a bushy herbaceous annual belonging to the saltbush or Goosefoot family somewhat resembles Russianthistle in appearance. It is closely related to the saltbushes of the western ranges and to the garden firebush or summercypress often used as an ornamental annual edging or border plant. Like its horticultural cousin, Belvedere summercypress turns red in the fall after frosting accounting for its common name, firespray. Further, it is an aggressive invader of disturbed areas and thrives under a wide range of conditions.

Belvedere summercypress was collected in the United States in 1914 near Green River, Wyoming, and at that time was already naturalized in many places throughout the West. In 1943 it appeared in eastern Montana in waste places and along roadways, in many areas in almost explosive proportions. For several seasons it dominated nearly all other species of weeds and considerable concern arose over the prospects of it invading native ranges and cultivated fields. At that time E. J. Woolfolk of the Experiment Station described the plant and what was known of its properties in the Montana Stockman (October 15, 1945). Since its first dramatic appearance in eastern Montana, Belvedere summercypress has surrendered its almost complete dominance of waste areas but has successfully maintained itself as part of the normal weed complement. At no time to date has the once feared, all-out invasion of fields or native range occurred. There seems need be little fear in this respect unless drought or misuse provide kochia with an unusual opportunity for invasion.

With more information on the plant, Belvedere summercypress assumes a guise of some virtue. Observations at Miles City during and following its eruption in that section showed it to be very palatable to cattle, horses, swine, and chickens. Further, it is widely adapted to a range of sites and is a copious producer of herbage, particularly where extra moisture is available. Under such conditions, it produces rapid and considerable regrowth following mowing or grazing.

Similar information has recently been released by the Intermountain Experiment Station in its 1949 Annual Report, including a possible and rather unique role for the plant in that section of the country. In tests on several different sites in central Utah near Ephraim, kochia produced 1,000 pounds of dry herbage per acre on a dry, rocky valley bench with 11 inches of annual precipitation; 1,600 pounds per acre in an oakbrush zone with 14 inches of precipitation; and up to 8,000 pounds per acre

under irrigation on soil too salty for any common crop. Seed yields of 2,000 pounds per acre were also reported under irrigation. Its adaptability to soils with a rather high degree of salinity suggests wide possibilities of use in the Intermountain region. The Utah tests also showed summercypress to be highly palatable to cattle and sheep either as green pasture or cut as hay.

Along with its high palatability, Belvedere summercypress compares with alfalfa hay in nutritional value based on chemical analyses. Bidwell and Wooten in U.S.D.A. bulletin no. 1345 reported that leafy branches of plants in late flower contained 23 percent protein, 1.8 percent fats, and 24 percent fiber; and tests by the Utah State Agricultural Experiment Station showed a range of 23 to 13 percent protein, depending on the stage of development, 4.0 to 1.7 percent fats, 29 to 16 percent fiber compared to 16 percent protein, 2.2 percent fats, and 32 percent fiber for alfalfa hay. -- NRM F&R Experiment Station release.

Wyethia Eradication Studies on the Targhee National Forest in eastern Idaho have recently been reported by W. F. Mueggler and J. P. Blaisdell of the Intermountain Forest and Range Experiment Station. Various methods and materials including a moldboard plow; a wheatland plow; an offset disk; creosote and diesel oil; ammonium sulfamate; kerosene; 2, 4-D; 2, 4, 5-T; and a mixture of 2, 4-D and 2, 4, 5-T were used. Moldboard plowing, while expensive, eliminated 75 percent of the wyethia. Within 3 years areas plowed and reseeded were producing 13 times as much herbage as untreated areas.

The herbicides were applied at 1 and 2 pounds acid equivalent per acre in water during two growth stages - "half bloom" and "blooming over." One year after treatment, all herbicides had caused a reduction in wyethia, ranging from 27 percent for 2, 4, 5-T applied at one pound per acre in the "blooming over" stage to 95 percent for 2, 4-D and a mixture of 2, 4-D and 2, 4, 5-T applied at 2 pounds per acre in the "half bloom" stage. Recovery of native grasses increased production on nearly all treated areas. The 2, 4, 5-T was less effective than either 2, 4-D or the mixture. Application of the herbicides at the "half bloom" stage was more effective than at the later date. The heavier rate, 2 pounds acid equivalent per acre, caused heavier wyethia losses than the one pound rate. Other materials used were not considered sufficiently effective to be practicable in the control of wyethia. -- Research Paper No. 25, dated December 1950, Intermountain F&R Experiment Station.

Orange Sneezeweed (Helenium hoopesii) Killed by 2, 4-D: This plant, occupying more than 2 million acres of range land in the central Rocky Mountains is poisonous to sheep. Clyde W. Doran, Rocky Mountain Experiment Station, reports that 4 pounds of 2, 4-D acid per acre applied during mid-summer will effectively control this range pest.

Tests made in early spring, mid-summer, and fall using 1, 2, and 4 pounds of pure acid per acre showed that only the 4-pound rate was effective and then only when applied in mid-summer. Further tests, made in mid-summer when sneezeweed was in the pre-bloom, early bloom, and full bloom developmental stages, using the ester, amine, and salt of 2, 4-D with fuel oil as a carrier produced good kills during this period in all stages. The ester gave the most consistent kills for all periods of application while the amine and salt seemed to be more effective during the pre-bloom stage. Water as a carrier was as effective as fuel oil. A jeep equipped with 20-foot booms was used satisfactorily for spray application in the large-scale tests.

While it is not injurious to native grasses, 2, 4-D does kill many broad-leaved plants in the range association. Control of sneezeweed infested areas should be attempted only when provisions can be made to restore a good grass cover through reseeding. Otherwise, sneezeweed reinvades treated areas rapidly. -- Vol. I, no. 1, January 1951, Journal of Range Management.

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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume III, Number 5. March 1, 1951

Methods of Transferring Photo Cover Types to Base Maps. Since an aerial photograph is not a map, transfer of forest cover type lines from aerial photos to base maps is necessary. On aerial photos forest types appear either too large or too small because of lens distortion and topographic displacement. Thus, any transfer method should attempt to minimize distortion and displacement and should also recognize standards of accuracy in base maps. Recent experience in transferring forest types from photos to base maps indicates that the method to be used depends on the quality of the base map and the degree of accuracy desired in the final type map. Transfer methods recommended for three kinds of base maps are:

1. Map base compiled from aerial photos with the multiplex projector, KEK plotter, or radial line plotter. In this case accurate type transfer is possible. On timber sale areas, for example, where values are high and the area relatively small the radial line plotter can be used to good advantage. An experienced operator can turn out 10 to 15 setups per day with the radial line plotter. For extensive survey or management plan work where the area to cover is large the double reflecting projector offers 2 to 4 times the output possible with the radial line plotter. Accuracy is less than the radial line plotter yet it is sufficient to meet most forestry needs.

2. Map base compiled from aerial photos using GLO plat control, or from GLO plats not based on aerial photos. It has been found that output with the radial line plotter is 4 to 7 setups per day where the base map control is poor. Generally, it is best not to use the radial line plotter on these bases, especially over extensive areas. For such areas with this kind of base the double reflecting projector offers the most output. Direct sketching may be used if a projector is not available. Though 10 to 15 percent slower than the projector method, sketching gives accuracy comparable to the projector and less work is required on the map after the initial transfer is made.

3. Reconnaissance bases or small scale forest bases built up from sketching. In this case the radial line plotter should not be used for it is an unjustified refinement on a relatively inaccurate base map. The double reflecting projector is difficult to use because control is lacking. Direct sketching is the method recommended because it offers the most output and accuracy in keeping with the quality of the base.

Prepared by the Division of Forest Economics

Estimating Cull and Defect on Standing Trees. In the central Rocky Mountain Region, E. M. Hornibrook found that most of the cull in mature and overmature Engelmann spruce, lodgepole pine, and alpine fir is associated with relatively few defect indicators. In order of importance they are: conks or fruiting bodies, swollen knots, sound produced when a tree is struck with an axe, decay showing on an increment core, lightning scars, frost and wind cracks, and top injuries. Hornibrook describes both the external defect indicators and volume deductions to be made when based on these indicators. Although based upon studies conducted in Colorado, the information should have application in the Northern Rockies. (Estimating Defect in Mature and Overmature Stands of Three Rocky Mountain Conifers, E. M. Hornibrook. Journal of Forestry, Vol. 48 (9). September 1950.)

Pulp Market Providing an Outlet for Timber in the Northern Rockies. A recent survey of pulpwood production in Montana, North Idaho, and Northeast Washington shows the following trend in pulpwood output for the past three years:

	Pulp logs (M bd.ft.)	Pulp bolts (standard cords)
1948	18,294	42,795
1949	25,066	50,906
1950	15,629	51,207

Beetle-Killed Spruce Trees Sound After 25 Years. A recent study made in a beetle-killed spruce stand in Utah found that 84 percent of the dead trees were still standing some 25 years after they had died. The major defect of the standing timber was season check, a factor of importance when trees are sawed into lumber.

Wind was found to be a relatively minor factor causing dead trees to fall; 17 percent was attributed to this cause. Butt and root rots accounted for over three fourths of the trees falling since death. The dead spruce trees apparently remain sound as long as they are standing. Down trees, however, begin to decay within a few years after falling, particularly if they rest directly on the ground.

The results of this study lend support to the belief that dead standing timber in the Northern Rockies remains sound for many years. (Rate of Deterioration of Beetle-Killed Engelmann Spruce in Utah, James L. Mielke. Journal of Forestry. Volume 48 (12). December 1950.)

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MISSOULA, MONTANA

Volume III, Number 6 March 15, 1951

Prepared in the Division of Range Research

Grazing Wild Hay Meadows: During the 7-year period, 1936 through 1942, three fields used for wild hay production under irrigation on the Circle Ranch near Big Piney, Wyoming, were grazed by cattle from the beginning of plant growth in spring to about May 3, May 26, and June 9, respectively. After grazing, the native forage plants in the fields; mostly sedges, bentgrass, wheatgrass, tufted hairgrass, timothy, and bluegrass; were allowed to grow until late July or early August. All three fields were then harvested for hay at the same time. Careful grazing use records were kept as a basis for calculating the weight of herbage harvested from each field by the cattle. These calculated values added to hay yields gave the total herbage yield from the three fields grazed to early, mid-, and late spring. Chemical analyses of harvested herbage samples, taken at haying time, gave the crude protein and total ash content of herbage from each field.

Total average herbage production; calculated grazed material plus weight of harvested hay; was 1.79, 1.89, and 1.93 tons per acre from the fields grazed to early, mid-, and late spring, respectively. Chemical analyses showed that the younger the hay, the higher the crude protein content. Crude protein percentages for the 7-year period averaged 8.13, 8.25, and 9.05 for the hay grown after early, mid-, and late spring grazing, respectively. The average acre-yields of crude protein were 291.1, 311.9, and 349.3 pounds. On a relative scale these averages were 100, 107, and 120. Total mineral content of hay on the relative scale was 100, 110, and 116 for the three fields.

It is clear from the foregoing data that when the hay meadows were spring-grazed for 20 to 35 days beyond the usual time, total herbage yield (hay plus pasturage) was increased and the hay so enriched in crude protein that the per-acre yield of protein was increased 20 percent by late spring grazing and 13 percent by mid-spring grazing. Because of the loss of protein in the hay during two years when cutting was delayed 41 and 47 days beyond the bloom period it was concluded that early cutting, regardless of past spring grazing, was a good practice. Herbage grown after haying can be grazed to advantage by beef animals en route to market or by stock cattle during the fall before winter feeding becomes necessary.

The data also indicate that indirect off-ranch values may be as great as the improvement in the ranch-grown feed. Keeping at least a part of the cattle herd on the ranch for 20 to 35 days additional spring grazing on hay meadows would relieve the grazing load on spring-early summer native ranges and at the same time increase the average yearlong production from the hay meadows. Most spring ranges would benefit by even temporary relief from the grazing load. Also, longer spring grazing on hay meadows permits better care of cows with young calves and gives the calves

themselves a good start on lush, nutritious herbage before moving to drier, rougher range. -- Abstracted from an article entitled "Effect of prolonged spring grazing on the yield and quality of forage from wild hay meadows." George Stewart and Ira Clark. Journal American Society of Agronomy 36(3):March 1944.

NOTE: The foregoing abstract was prepared in accordance with a special request for specific, needed information. This is a new and we believe a worth-while means of making Research Hi-Lites help to get the job done. Hi-Lite readers are hereby invited to tell us what their special range interests are and to make suggestions concerning the kind of information they think should be carried in future Range issues of Research Hi-Lites.

Wheat Poisoning: According to the Journal of the American Veterinary Medical Association the condition in cattle called wheat poisoning or grass staggers is due to a lowering of mineral levels in the animal's body. Cattle that have been on wheat pasture for 30 days or longer may "go crazy" while being handled or loaded for shipment. Stricken animals are easily excited and may attack handlers. They lose coordination and eventually may become unable to stand. Death losses may run as high as 40 percent. Analyses of blood taken from affected animals have shown an unbalance of the magnesium-calcium ratio and lower than usual levels of both minerals. Blood sugar is often low also. Low magnesium levels cause nervousness and low calcium may bring on unconsciousness. Injections of mineral solutions into the blood stream, given in time, may save stricken animals. -- "The Cattleman," February 1951.

Shades and Showers for Cattle: To help livestock beat the heat and make more efficient use of their feed, University of California and the Bureau of Plant Industry, Soils, and Agriculture Engineering, U. S. D. A, research workers have developed artificial shades and automatic showers for cattle. To be most effective in reducing radiated heat a shade structure should be built on grassland rather than bare ground and should have a hay-covered roof 12 to 14 feet above the ground. In actual tests cattle preferred a 12-foot shade to a 7-foot shade, identical except for height and placed side by side. Other tests showed that cattle made greater gains on pasture when both shade structures and automatic cool showers were available than did similar cattle during the same period with access only to shade. -- "The Cattleman," February 1951.

Protein and Carotene in Bromegrasses: Numerous agricultural scientists have found that important differences in nutrient value exist between races, strains, and individuals of the same grass species grown on a uniform soil under similar conditions. Recent work by R. C. Pickett at the University of Wisconsin supports these findings.

Pickett compared the protein and carotene content of 25 families of bromegrass that differed in origin and other characteristics, by growing plants of each under uniform conditions. He found highly significant differences between families in carotene content - which is important as a source of vitamin A - and in protein at the time when plants would first be grazed in the spring, as well as at later stages. Protein and carotene were more closely related to degree of green color at the early pasture stage and at flowering than to such other characters as leafiness, height, and vigor. -- Agronomy Journal, vol. 42, no. 11, November 1950.

Montana's 1950 Crested Wheatgrass Production: According to a recent B.A.E. report 34,000 acres of crested wheatgrass were harvested for seed in Montana during 1950. Average yield per acre was 91 pounds and a total of 3,100,000 pounds of seed was harvested. Growers received $13.00 cwt. for this seed.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Volume III, Number 7 April 2, 1951

Prepared in the Division of Flood Control Surveys

"The economic yardstick now used to determine the best use of land is by no means a safe one from an ecological or biological point of view. Economics has given us strip lands over coal beds and stone fields in rich narrow valleys over gold bearing gravels. Much the same approach gives us barren moss and lichen-covered hills where redwood forests stood; bracken fields where Douglas-fir or cedar and hemlock were produced; great areas of downey chess where bluebunch wheat grass, or Idaho fescue produced a dense cover; snakeweed and burrow-weed where valuable gramas covered the soil, and nearly bare soil on our mountains once knee-deep in lush vegetation. The sustained high price of wheat has reduced much of the grass cover of the High Plains to nearly bare soil - a potential dust bowl."--From an editorial by H. L. Shantz in the October 1950 issue of the Journal of Forestry.

What is a natural resource? Natural resources are material goods provided by nature which may be used for the benefit of man. In George T. Renner's "Conservation of Natural Resources," they are classified according to the following scheme:

Inexhaustible:
- Immutable - solar power, wind power, air.
- Misusable - water power, scenery, surface water bodies.

Exhaustible:
- Maintainable:
  - Renewable - soil fertility, timber, grassland, underground water.
  - Non-renewable - soil, specific species of trees, flowers, birds.
- Non-maintainable:
  - Reusable - metals, non-metallic minerals.
  - Non-reusable - petroleum, natural gas, coal.

Watershed managers measure time in "stream flow years" or "water years." "The 'water year' begins October 1 of each year. This date is generally used by hydrologists because it is at the end of the growing season for most of the country, the end of the period of high transpiration and evaporation. October 1 begins the period of replenishment, the season when there is an excess of precipitation over water losses. During the fall and winter months, soil moisture is built up, ground water replenished, and streams again reflect the additional moisture."-- W. O. Information Digest, No. 103, November 21, 1950.

The cold facts are that the depth of snow may have little relation to the amount of water stored in the snow pack. On March 7, 1951, at the Priest River Experimental Forest, an 8-inch core of new-fallen snow produced 0.25 inch of water. This indicates a density of 3-1/8 percent. It would require 32 inches of such snow to equal 1 inch of water. On the other hand, densities of around 50 percent, 1 inch of water in 2 inches of snow, are rather common in packed snow during the spring melt period. Density of newly fallen snow is commonly around 8 to 10 percent.

Protection of the soil from the damaging effects of repeated freezing and thawing is an important reason for maintaining good litter or vegetative cover that has received little consideration until recently. In an article in the January 1951 issue of the Journal of Soil and Water Conservation entitled "Winter Aspects of Soil Structure," C. S. Slater of the Soil Conservation Service, Beltsville, Maryland, indicates that repeated freezing and thawing has bad effects upon soil structure by reducing stability of the soil aggregates in water, decreasing infiltration rates and pore space, and by increasing volume weight. He not only measured these damages by scientific soil tests but proved by growth tests that frequent freezing and thawing reduces productivity of the soil.

Though Mr. Slater's studies were made on agricultural soils, it is reasonable that the same bad effects are bound to occur on grazing lands left bare and unprotected through the winter because of overgrazing, or on forest soils made bare by fire or bad logging practices.

Year by year the evidence is becoming more conclusive that if we will be less greedy in taking from the soil, and more generous in leaving a portion of each year's crop for soil protection and maintenance, nature will reward us with more bountiful crops, better watershed conditions, fewer floods, and the means for a better way of life in general.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

Volume III, Number 8 April 15, 1951

Prepared in the Division of Range Research

Summer Grazing Retards Infiltration of Water into High Mountain Range Soils: Infiltration tests were made in 1949 on selected areas of the Sheridan Ranger District and Vigilante Experimental Range, Beaverhead National Forest, representing four intensities of use. Areas which had been heavily, moderately, and lightly grazed by cattle and big game animals for many years were compared with adjacent, similar areas that had been protected from cattle grazing for at least 14 years. An average of 30 infiltration trials were made on each area using a tin-can infiltrometer. One inch of water was applied and timed until disappearance and then a second inch added to the same set-up and likewise timed.

The average time in minutes required for the disappearance of the first and second inches of water by intensity of use is shown in the following table:

Water applied	Protected	Heavily grazed	Protected	Moderately grazed	Protected	Lightly grazed
First inch	5.04	8.02	10.36	18.06	9.29	9.83
Second inch	15.56	21.56	25.43	38.00	27.55	25.50

Infiltration of the first inch of water took 59 percent longer on heavily grazed range than on the adjacent protected area, 74 percent longer in the moderately grazed-protected comparison, and 6 percent longer on lightly grazed range than on the protected area. Results from applying the second inch of water were similar except for the lightly grazed-protected comparison in which disappearance of the water took 8 percent longer on the protected area. These data indicate that the infiltration of water into grazed cattle range soils in this locality may be somewhat slower than on similar ranges not recently grazed by cattle. -- NRM F&R Experiment Station release.

TCA Shows Promise As A Killer of Weedy Grasses: Agronomist L. M. Stahler of the United States Department of Agriculture reports that TCA (sodium salt of trichloroacetic acid) has been found to control yellow foxtail (Setaria species), barnyard grass (Echinochloa species), and panic grass (annual Panicum species) seedlings without damage to sugar beets. Table beet, flax, alfalfa, and other legume crops have also shown a tolerance for TCA. With more study of treatment practices and dates, Stahler believes TCA will become one of the most dependable killers of quackgrass, Johnson grass, and Bermuda grass.

Damage to perennial weeds occurs when TCA comes in contact with the roots; above-ground foliage being affected but little. The effectiveness is increased if applications are made at a time of the year when soil moisture conditions or rainfall aid in the leaching of the poison to root levels.

More study is necessary to establish the most efficient rates, according to Stahler. Good results were obtained using 40 pounds per acre while the 80-pound-per-acre rate was found to be excessive. -- USDA, Agriculture Research Administration, press release number 146, Washington, January 18, 1951.

Manchar Smooth Brome resulted from the selection of plants grown from seed received in 1935 from the Kungchuling Experiment Station. R. H. Stark and K. H. Klages report that it is adapted to the Pacific Northwest. Although a sod-forming grass, Manchar does not become sod-bound as rapidly as ordinary smooth brome. Its leafy characteristic makes it desirable for hay production. Seeded in pure stands or in mixture with alfalfa, Manchar has produced higher yields than common strains of brome or alfalfa seeded alone. As a pasture grass, Manchar brome remains productive longer than the more common strains.

Manchar is a high seed producer. Yields from row seedings are generally higher than those from solid seedings. The seed is easy to harvest with a binder. This method permits field curing in the shock thus minimizing seed loss from shattering.

Successful stands have been obtained from spring and fall seedings and even from summer plantings on irrigated land. Manchar can be seeded in mixtures wherever a legume stand can be established.

Foundation seed only for seed production plantings can be obtained through the Idaho Agricultural Experiment Station, University of Idaho, Moscow; or some Soil Conservation Districts. Certified seed for hay and pasture seedings or production of certified seed can be obtained from county extension agents or the Idaho Crop Improvement Association at Boise. -- Bulletin number 275, U of Idaho Agricultural Experiment Station, Department of Agronomy.

Early Cutting of Alfalfa Results in a Protein Content Reduction and a Thinning of the Stand: Cooperative investigations conducted in Mississippi by the United States Department of Agriculture and the State Agricultural Experiment Station have shown that repeated cutting of alfalfa in the pre-bloom stage reduced the productiveness of the stand after two or three years.

A three-year-old stand of Kansas common alfalfa averaged 10 to 12 plants per square foot at the initiation of the study. One year later, study areas cut in the pre-bloom stage averaged only 0.1 plant per square foot compared with 7 plants per square foot on areas cut in the bloom stage. A stand of Buffalo alfalfa, after two years, averaged 2.6 plants to the square foot on plots cut in the pre-bloom stage and from 12.3 to 14.9 plants per square foot on plots cut at later growth stages.

Although protein content of alfalfa cut in the pre-bloom stage averaged 23.49 percent as compared with 18.32 percent for full flower-cuttings, total yield per acre of protein was considerably lower for the earlier cutting.

In the opinion of the investigators alfalfa stands cut when one-fourth the plants are in the bloom stage will maintain original density longer than stands cut prior to blooming. -- USDA, Agriculture Research Administration, press release number 79, January 11, 1951.

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Volume III, Number 9 May 1, 1951

Larch--Douglas-fir Vigor Classification. The preliminary vigor classification for western larch and Douglas-fir which the Station proposed in 1948 (see Research Note No. 66) was designed for trees 10 inches d.b.h. and larger. However, it seems to rate the growth of smaller residual trees about equally well. Diameter growth for a 10-year period following logging is shown below:

Vigor class	Western larch		Douglas-fir	
	4" to 9"	10"	4" to 9"	10"
A	1.25	0.90	1.31	1.02
B	0.63	0.53	0.82	0.64
C	0.37	0.36	0.57	0.44

Resistance of young ponderosa pine to killing by fire. From a July 1949 forest fire in Wilmont Creek on the Colville Indian Reservation, Washington, came the idea for a study to measure the ability of young ponderosa pine to withstand killing by fire. This study was suggested by Forest Supervisor Henry Wershing of the Colville Indian Agency; information on burning injury will help in appraising forest fire damage and in developing guides for prescribed burning in slash disposal and stand improvement. The present report lists only mortality of 200 sample trees within one growing season after the fire. Further mortality may show up later, and more time must pass before the full effects of fire upon growth and stem scarring can be evaluated.

The Wilmont Creek fire occurred July 15, on an afternoon when fire danger at Nespelem and Republic, Washington -- the two nearest stations - measured 60 and 70, respectively. Surface fuels were composed of grass, pine needles, and light litter.

The ponderosa pine trees in the study ranged from 30 to 50 years in age and from 2 to 7 inches d.b.h. Injury was measured in terms of defoliation (percent of crown destroyed) although the dying of some of the smaller trees may have resulted from killing of the bark and cambium. Except where injury was very severe, small diameter trees suffered greater mortality than larger trees for a given degree of crown injury. A few 2-inch trees that had retained 40 to 50 percent of their original crowns in undamaged condition died. However, no 3-inch trees that had live crowns of 30 percent or more died, and no trees 4 inches or larger died when live crown exceeded 20 percent of the original. Where injury was very severe, with

10 percent or less of live crown remaining, all of the 5-, 6-, and 7-inch trees died, although a few of the 3- and 4-inch trees lived. No differences in mortality among the four crown classes -- dominant, codominant, intermediate, and suppressed -- were found except those which were associated with d.b.h.

The average for all size classes showed that mortality was 100 percent when 5 percent or less of the crowns remained alive after the fire. With live crowns of 6 to 10 percent, 73 percent of the trees died, and with live crowns of 11 to 20 percent only a third of the trees died. No mortality occurred when more than half of the crown was left alive.

Growth of 3-year-old hybrid pine. Early in 1948 the Station received a small lot of hybrid lodgepole pine x jack pine seed which had been produced at the California Forest and Range Experiment Station. These seed were planted at Savenac Nursery in May or the same year. In May and June of 1950, trees from the hybrid seed and from ordinary lodgepole pine and jack pine were field planted as 1-1 stock into permanent test plots on the Priest River Experimental Forest, Lubrecht Experimental Forest, and the Lewis and Clark National Forest.

The average heights of these 3-year-old trees in September 1950 were:

Lodgepole pine x jack pine	0.51 foot
Lodgepole pine	0.30 foot
Jack pine	0.73 foot

In appearance, as well as in height, the hybrids are intermediate to the trees of their parent species.

By hybridizing trees, forest geneticists hope to combine the better qualities of the parents. In the case of jack pine and lodgepole pine, the two species have many similarities, but jack pine excells in growth rate and lodgepole pine is superior in longevity and stem form.

# # # # #

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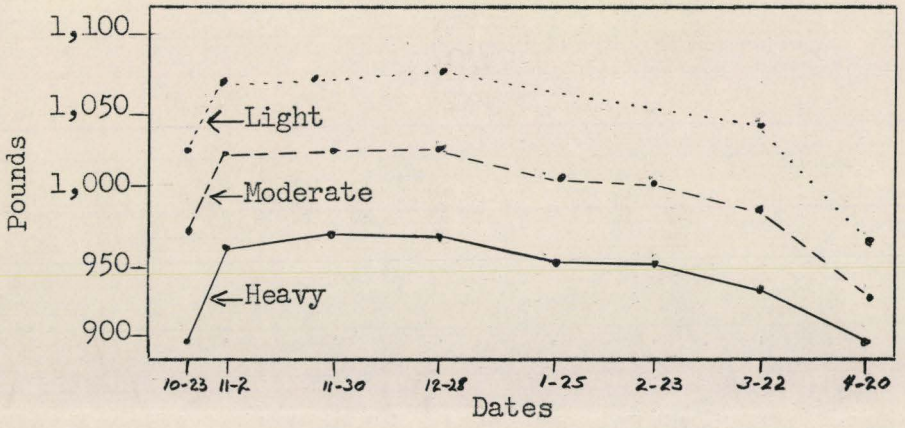
MISSOULA, MONTANA

Volume III, Number 10 May 15, 1951

Prepared in the Division of Range Research

Range Stocking Rate Affects Cows on Winter Range: Range cows in experimental grazing studies at Miles City wintered satisfactorily and without loss but showed the effects of rate of range stocking throughout.

Weights of cows on winter range
Three rates of stocking



Cows on heavily stocked range that went into the winter weighing 912 pounds, on the average, gained in weight until about the end of December then declined steadily even though they received 851 pounds of hay per head between January 16 and March 31. Their peak weight in December was 970 pounds and on April 20 they averaged 904 pounds.

Under moderate stocking range cows started the winter at an average weight of 989 pounds. They reached their peak weight of 1,027 pounds late in December and declined to an average weight of 933 pounds on April 20. Hay fed to this group averaged 698 pounds per cow for the period January 27 to March 23.

Cows on lightly stocked range weighed 1,038 pounds on the average at the start of the winter season. Their heaviest average weight, 1,077 pounds, was attained late in December. By April 20 they had declined to an average weight of 967 pounds. Hay fed this group between January 27 and March 23 averaged 699 pounds per cow.

Fall-early winter gains averaged 58, 38, and 39 pounds, respectively, under heavy, moderate, and light range stocking. Percentage-wise these gains were 6.4 percent,

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3.8 percent, and 3.8 percent of the fall weight averages. From winter peak to spring, weight losses averaged 66 pounds (6.8 percent), 84 pounds (8.2 percent), and 110 pounds (10.2 percent), respectively. Over-all change in weight from fall to spring by lots was 8 pounds (0.8 percent), 56 pounds (5.6 percent), and 71 pounds (6.8 percent) under heavy, moderate, and light range stocking.

Cows on heavily stocked range gained more pounds per head and percentage-wise during fall and early winter than cows on moderately and lightly stocked range because they were in poorer condition and benefited more by fresh fall range than did the others. They lost less weight both in pounds and percentage-wise, than the others because they had less to lose and also because they received slightly more supplemental hay than the others. -- NRM F&R Experiment Station release.

Three New Range Publications Issued: USDA Circular No. 865, "Managing Northern Great Plains Cattle Ranges to Minimize Effects of Drought," March 1951, describes the response of range vegetation and cattle grazed on experimental native range pastures at Miles City to the 1934-1936 drought. During these years, drought conditions in the northern Plains were the most severe ever recorded. Native grass and cultivated forage crops failed and a large percentage of the livestock on the Plains was sacrificed at forced sales or starved. Calves produced during 1934, 1935, and 1936 on heavily stocked experimental ranges failed to return total feed costs; while on range pastures stocked moderately and lightly, calf returns were about 80 percent greater than feed costs in 1935 and 1936. Information from this study and other experience suggests that the effects of drought may be minimized by the following basic range management practices: (1) conservative stocking, (2) adequate supplemental feed supplies, (3) provision for adequate salt and stock water, (4) early breeding season, (5) seasonal use of the range, (6) uniform distribution of livestock over the range, and (7) inclusion of both steers and cows in the commercial herd. Recommended adjustments during drought years include (1) close culling of dry cows, undesirable bred cows, and steers; (2) early marketing of culled animals; (3) changes in the plan of seasonal use to utilize early starting forage species; and (4) caution in restocking the range before good vigor has returned to the forage plants.

An unknown but considerable acreage of abandoned plowed land and deteriorated range in the western States has been reseeded to crested wheatgrass. Research Note No. 91, "Crested Wheatgrass Grazing Values," March 1951, tells of a 12-year grazing trial on crested wheatgrass pasture at Miles City. During the first 11 years, 46 acres of crested wheatgrass were grazed heavily each season by steers and mixed heifers and steers during a maximum period starting as early as grazable forage was available. Several important lessons in grazing crested wheatgrass under eastern Montana conditions were learned: (1) for spring and early summer grazing, crested wheatgrass provides highly palatable, nutritious forage capable of producing rapid gains on feeder cattle; (2) it is extremely resistant to grazing use but for high sustained production stocking should be under one animal unit month per acre on the average, with considerable freedom to vary the starting date and length of season in accord with weather conditions; (3) grazable forage may be expected on the average, between early April and early May, but most often during late April; (4) usually a spring-summer grazing season of 100 to 120 days can be expected and some fall grazing may be provided in about one-third of the years over a long period.

Research Note No. 98, "Response of Wyethia to 2, 4-D," April 1951, gives the full details of a preliminary test on the killing action of 2, 4-D on Wyethia reported in the July 15, 1950, issue of Research Hi-Lites. Six thousand and 10,000 ppm of 2, 4-D in water or diesel oil gave almost complete kills of Wyethia and reduced perennial weed cover; diesel oil as a carrier, however, appeared to be deleterious to perennial grasses. No significant increase in perennial grass cover occurred one year following spraying on areas where Wyethia had been killed.

Copies of these three publications are available upon request from the Northern Rocky Mountain Forest and Range Experiment Station. -- NRM F&R Experiment Station release.

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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume III Number 11 June 11, 1951

WOOD MOLASSES FOR LIVESTOCK FOOD

Foresters and lumbermen have been concerned for a long time over the vast amounts of waste wood left after logging, and the sawdust and other waste at sawmills. Production of livestock feed from these wood wastes may soon be a common practice. The size of the sawdust pile in the Northern Rocky Mountain area is immense, almost 1/2 million tons. Some of this vast woodpile is in such unhandy form or in such inaccessible locations as to be uneconomically usable. However, varying amounts of it are used as fuel for generating steam, as a soil amendment, and otherwise. A still higher use of this material would no doubt be as livestock food. Scientists of the Forest Products Laboratory, Madison, Wisconsin, have found that about 1000 pounds of edible sugar can be produced from a ton (dry weight) of wood. Wood converted to sugar has proved to be a satisfactory constituent of food for livestock. When wood is treated with a dilute sulphuric acid solution, molasses, very similar to blackstrap, is produced. Molasses from the sugar cane and sugar beet industry has long been used for livestock food.

Stockraising looms big in the Montana economy. A review of the present and potential feeding situation is interesting. Fifteen or 20 years ago less than 8000 gallons of molasses were used annually for processed livestock food compared with 250,000 gallons today. A tentative estimate by a competent livestock feed authority indicates that 800,000 to 1 million gallons of wood molasses could be used in the manufacture of processed feed if the molasses were available in that quantity at a reasonable cost.

In addition, wood sugar molasses could be fed to range cattle and sheep as a winter food supplement. If only 25 percent of the 2 million cattle and 2.1 million sheep in Montana were fed wood molasses as a supplemental feed a market for approximately 25 million gallons could be created for that purpose. Reliable estimates indicate there are at least 200 tons of wood waste developed daily in Montana in locations tributary to main line transportation, enough to make 40,000 gallons of wood molasses daily, or 12 million gallons a year. Over a long period of years it should be possible to develop a market in Montana for 25 million gallons of wood molasses, or about twice the amount that could be produced from available wood waste. Some day such an industry may develop.

Prepared by the Forest Utilization Service

To the Agricultural College Experiment Stations of the Northwest goes much of the credit for determining the worth of wood molasses as a livestock food. Recently Director Clyde McKee of the Montana Agricultural Experiment Station, Bozeman, Montana, summarized the results of this work before the Northwest Wood Products Clinic at Spokane, Washington. A copy of his paper is attached.

Attachment

GEORGE M. JEMISON, Director

I. V. Anderson, Chief, Forest Utilization Service

EXPERIMENTAL FEEDING OF WOOD MOLASSES *

by

Clyde McKee, Director
Agricultural Experiment Station
Montana State College

INTRODUCTION

In 1943, the U.S. Forest Products Laboratory started an intensive study of the production of wood sugar for alcohol, as a war-time project, and as a result, developed several improvements in the process of converting wood to sugar solutions. Additional knowledge thus acquired made possible new, highly efficient equipment which has reduced the cost of evaporating the sugar solution so that a 50 percent solution of wood sugar could be produced at a price which would make it attractive as a source of high-energy feed for livestock.

At this stage of development, Research and Marketing Act funds were supplied to the Forest Products Laboratory to permit the production of wood molasses for feeding tests by agricultural experiment stations. The Forest Utilization Service of the various forest and range experiment stations were helpful in obtaining wood molasses for experimental feeding trials at the state agricultural experiment stations.

PRELIMINARY FEEDING EXPERIMENTS.

Most of the preliminary studies to determine the value of wood molasses for the feeding of livestock were conducted during the five-year period between 1945 and 1950. Two reports by E. E. Harris, Forest Products Laboratory, "Wood Molasses for Stock Feed" and "Hydrolysis of Wood for Stock Feed", present a summary of these preliminary studies. It will be sufficient at this point to state that preliminary studies with wood molasses were conducted at (1) The Southern Forest Experiment Station; (2) Michigan State College; (3) University of Wyoming; (4) Oregon State College; (5) State College of Washington; (6) University of New Hampshire; (7) University of Wisconsin; and (8) Montana State College, possibly also at a few other locations.

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*The author wishes to acknowledge the assistance of the administrative and research staffs of the Agricultural Experiment Stations of Idaho, Montana, Oregon, Washington, and Wyoming; the Northern Rocky Mountain Forest and Range Experiment Station at Missoula, and the Forest Products Laboratory at Madison, Wisconsin, in making available information upon which this paper is based.

REVIEW OF WOOD MOLASSES STUDIES AT THE AGRICULTURAL EXPERIMENT STATIONS OF THE FIVE NORTHWESTERN STATES * *

The information which follows has been summarized from statements furnished by the administrative and research staffs of the Agricultural Experiment Stations of Idaho, Montana, Oregon, Washington, and Wyoming. The first inquiry was made on September 11, 1948, prior to the preparation of a proposed cooperative regional research project to be financed by Research and Marketing Act funds. The second inquiry was made on February 26, 1951, to assemble information for a paper to be presented at the Northwest Wood Products Clinic at Spokane, Washington, on April 10 and 11, 1951. The work done with wood molasses in the Northwest can be reviewed more quickly by handling each state separately.

Idaho Agricultural Experiment Station: This station has used wood molasses in feeding experiments with (1) dairy cattle; and (2) swine. The results are preliminary and far from conclusive.

(1) Dairy Cattle: Lodge pole wood molasses, mixed with equal parts of water, poured over silage, and then ground grain mixture placed on top of the silage-molasses mixture. Observations: (a) This particular type of molasses was not palatable to most cows, but they appeared to become accustomed to it. (b) No ill effects such as scours or other unusual symptoms were observed.

(2) Swine: Lodge pole wood molasses used in palatability test in 1947 with sows and gilts of Poland China and Duroc breeds. Molasses fed free-choice as 10 percent of the grain ration and 5 percent of the total ration. The molasses-grain mixture was fed in one self-feeder and ad libitum to the gilts and in a trough, hand-fed, to the sows. In both cases, the hogs had access to the same grain mixture without molasses. Observations: (a) "Molasses used appeared very bitter to the taste"; (b) "When swine had access to rations without molasses, very little of the molasses feed mixture was consumed"; (c)"Neither gilts nor sows consumed the molasses-grain mixture freely."

Oregon Agricultural Experiment Station: Wood molasses studies have included (1) dairy cattle; (2) swine; (3) sheep, and (4) laying hens. In addition, this product has been used in experiments to improve the quality and palatability of low quality hay and to preserve alfalfa and grass silage.

(1) Dairy Cattle: Oregon Station Cir. 181, published in September, 1949 - "Wood Sugar Molasses for Dairy Cattle", -- is authority

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* * This section of this paper is based on replies to letters of inquiry addressed to the directors of state agricultural experiment stations of the five northwestern states.

for the following summary: (a) "Wood sugar molasses diluted with water and sprinkled over low quality hay proved to be as palatable as cane molasses for dairy heifers"; (b) "From the feed consumption records it has been calculated that 100 pounds of wood sugar molasses of 56 percent dry matter content is equal to 77 pounds of cane molasses with 74 percent dry matter"; (c) "Cows showed a slight preference for alfalfa ensiled with 3 percent wood sugar molasses to alfalfa silage made with 3 percent cane molasses"; (d) "There was no appreciable difference in feeding value for dairy cows as measured by milk production and weight changes of alfalfa ensiled with wood sugar molasses or with cane molasses."

(2) Swine: The Oregon Station reports - "Enough feeding trials have been conducted to demonstrate feasibility of incorporating Douglas Fir wood molasses in rations for swine providing such a procedure is economically sound. Observations (a) up to 15 percent of the ration when properly supplemented, wood molasses has a feeding value pound for pound equal to grain: (b) "The palatability of fresh pork is not affected by feeding wood molasses to hogs."

(3) Laying Hens: Based on investigations to date, ... "it would appear that the inclusion of 7½ percent wood sugar molasses to replace an equal amount of grain in the ration (wheat, corn, and oats) brings about an increase in egg production."

(4) Sheep: Results from an experiment with sheep in 1950 indicate that wood molasses ..... "may eventually replace a considerable amount of grain as a source of carbohydrate in lamb fattening rations." If wood molasses is made available to the sheep man cheaply enough, a considerable saving may be made in his feeding operations.

Washington Agricultural Experiment Station: Director Buchanan and his associates have furnished information on feeding wood molasses to (1) dairy cattle; (2) chicks, and (3) beef cattle, and on wood molasses as a silage preservative.

(1) Dairy Cattle: "Wood molasses may well be an important dairy cattle feed if its palatability can be improved." Washington results indicate wood molasses not as palatable as either cane or beet molasses.

(2) Preserving Silage: Silage preserved with wood molasses seemed to be slightly more palatable and better preserved than silage to which no preservative had been added.

(3) Chicks: Scientific Paper No. 752, College of Agriculture and Agriculture Experiment Station, Institute of Agricultural Sciences, State College of Washington, entitled - "Wood Sugar Molasses as a Feedstuff for Chicks," summarizes experiments in which wood molasses was used as a substitute for part of the corn and wheat.

Observations: (a) "Wood molasses may be used satisfactorily as a substitute for cereal grains when additional protein is added to the diet by soybean oil"; (b) "Levels of wood molasses up to 20 percent

did not have a laxative effect"; (c) "Even though there was a tendency for the higher levels of wood sugar molasses to depress chick growth, the chicks were not significantly smaller than those receiving no molasses."

(4) Beef Cattle: In fall of 1949, wood sugar molasses was fed to fattening beef steers; average rates after 120-day period were about 12 percent and 15 percent of the concentrates. Observations: (a) Under open-trough feeding, the cattle refused any wood sugar molasses (b) Became necessary to force consumption by pouring molasses over the grain; (c) Grain consumption was limited because cattle fed molasses were the ones with the smallest appetites; (d) Apparently the wood sugar molasses used in these trials was quite unpalatable.

Wyoming Agricultural Experiment Station: No work done on wood molasses since the project was closed on June 18, 1948. Tests with dairy cows made possible the following observations:

(1) "Cows appeared to relish 5 percent molasses feed mixtures as much as the feed with no molasses."
(2) "The 10 percent mixture was damp, and strong smelling, and not accepted as readily."
(3) "No off-flavor could be detected in the milk."

Montana Agricultural Experiment Station: Feeding experiments with wood molasses were started in 1946-47 and have been conducted each year since. Livestock used included beef cattle, sheep, and dairy cattle.

(1) Beef Cattle: Four groups of steers were fed for 130 days during the winter of 1948-49 on the Wine Glass Ranch near Helmville, Montana. Wood molasses Douglas-fir and pine, containing 63.4 percent dry matter was used in preparing pelleted concentrates. Soybean meal was used to bring the crude protein content to approximately 15 percent. Molasses constituted 7 and 11 percent of the pellets. Concentrates were fed in pellet form and limited to approximately 10 pounds per day and all the native hay the cattle would eat. Observations: Rations containing wood molasses were apparently as satisfactory as the ration containing cane molasses and the ration containing no molasses.

(2) Sheep: The Montana Station has studied wood molasses as a feed for sheep during each of four winter feeding periods.

During 1946-47, palatability and toxicity observations were made on 40 to 50 sheep which received wood molasses at the rates of 2,4 and 10 percent from February until May. The rations with all three percentages of wood molasses were consumed at all times, and no toxic effects were observed.

During 1947-48, wood molasses rations were used in comparative feeding test involving 4 lots of 17 lambs each. No significant difference between the gains of the four lots, and no evidence of toxic effects.

During 1948-49, 68 lambs, divided into 4 lots to compare wood molasses (16.7 percent and 8.3 percent) and cane molasses with ration containing no molasses. Observations: (a) lambs can

fed for a normal fattening period on rations containing wood molasses with no apparent ill effects on health or well-being of lambs. (b) Possible that feeding value of wood molasses may be slightly below that of cane molasses on a dry matter basis for fattening lambs. (c) Cooking and palatability tests on lamb legs did not indicate that the bitter flavor characteristic of wood molasses was imparted to the meat.

During 1949-50, four lots of 18 lambs each were used to compare four rations over a period of 108 days. Observations: (a) The two lots receiving wood molasses (20% and 10%) made slightly larger daily gains than those receiving no molasses and cane molasses; (b) Feed consumption among the lots was similar with less hay weighback in the wood molasses lots; (c) The wood molasses lots were more efficient in feed utilization than the other lots.

(3) Dairy Cattle: Experiments with dairy cattle in 1948-49 showed (a) No off-flavor in the milk; and (b) wood molasses rations were equal to those containing cane molasses.

QUESTIONS REGARDING FUTURE OF WOOD MOLASSES

The directors and research staff directly concerned in each of the agricultural experiment stations of the five northwestern states were requested to prepare answers on four questions concerning the use of wood molasses as a feed for livestock.

Has Your Station Discovered Serious Objections to Wood Molasses as a Feed For Livestock? One station raised no objection to wood molasses. Two stations emphasized the "bitter taste" possessed by this product. Two stations referred to objectionable foreign material in the molasses. One station described this material as "crud" which clogged the molasses lines during the pelleting process. The other station described the foreign material as "bark residue" which looked like asphalt in the bottom of the barrels.

One really serious objection from the standpoint of reliable research is the fact that as yet, wood molasses has not been standardized, to insure the use of a uniform product in feeding tests in different parts of the region, or of the United States.

Several workers mentioned the necessity for using ammonia and lime as neutralizing agents to overcome acidity. In at least one instance, molasses which had not been neutralized sufficiently during the manufacturing process corroded holes in metal drums during the period of storage.

Do the Results Obtained from Feeding Wood Molasses Indicate that this Product is a Satisfactory Constituent of Rations for Livestock or is Further Experimental Work Needed to Establish the Value of Wood-Sugar Molasses? Stations in three of the northwestern states recommend additional study of the possibilities of

using wood molasses as a feed for livestock. One other station reports that the product is a satisfactory constituent of rations for livestock, but additional research is needed.

After four years of work, the Montana Station reports that wood molasses is a satisfactory carbohydrate feed for sheep and for incorporation into commercial pellets. No further experimental work needed until wood molasses of standard quality is readily available on the market at a price which will make it attractive for livestock feeding.

Do You Anticipate that Stockmen Will Make Extensive Use of Prepared Feeds Containing Wood Molasses, Assuming Availability at Prices that are Favorable? General impression is that as long as cane and beet molasses are available at favorable prices, the demand for wood molasses will not be strong. Almost without exception, the stations of the northwestern states are of the opinion that wood molasses must be made available at prices less than those charged for cane and beet molasses if the former product is to be used extensively in prepared feeds for livestock.

Have Feed Manufacturers in Your State Indicated Any Interest in Incorporating Wood Molasses in their Prepared Feeds? In only two states, Montana and Oregon, have the manufacturers of commercial livestock feeds indicated a definite interest in wood molasses as a constituent of prepared feeds. In these states, feed manufacturers have asked if and where they could purchase wood molasses.

SOME CONCLUSIONS

Information collected from studies ranging from preliminary observations and tests to comparative experiments with checks or controls make it possible to draw some conclusions relative to the possibility of satisfactory use of wood sugar molasses as a feed for livestock.

1. Wood molasses, used as a constituent of grain concentrates, has been fed to cattle, sheep, swine, and poultry without any apparent toxic effect or serious interference with animal growth.

2. In no case has wood molasses fed to dairy cows produced any off-flavors in milk.

3. There is some evidence that satisfactory results from feeding wood molasses is dependent upon thorough mixing of the product with the concentrate or mixed grain ration.

4. Cooking and palatability studies with meat from lambs and hogs fed on wood molasses feed mixtures have failed to detect any undesirable flavors.

5. Wood molasses thus far made available is apparently more palatable to sheep than to any other class of farm animals.

6. The most serious objections to the wood molasses currently available are (1) its bitter taste, and (2) its variable quality, particularly with reference to acid content and foreign matter.

7. Until wood molasses of a standard quality becomes readily available on the market at prices advantageous in comparison with those on other sources of carbohydrate or high-energy feeds, most agricultural experiment stations will direct attention to more pressing problems.

TABLE I - Classes of Livestock Used in Wood Molasses Experiments

State	Beef Cattle	Dairy Cattle	Sheep	Swine	Poultry	Turkeys
Idaho	—	Yes	—	Yes	—	—
Montana	Yes	Yes	Yes	—	—	—
Oregon	Yes	Yes	Yes	Yes	Yes	—
Washington	Yes	Yes	—	—	Yes	Yes
Wyoming	—	Yes	—	—	—	—

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

December 18, 1951

Prepared in the Division of Range Research

Weights of Cattle On Experimental Range: Weights and gains of cattle on national forest summer ranges are seldom systematically recorded, therefore, little information is available concerning this important subject. The following record was obtained during the 1951 grazing season on the Vigilante Experimental Range.

On June 1, the beginning of the grazing season, 162 head of mixed cattle were weighed and placed on the Vigilante Experimental Range located on the Upper Ruby River in southwestern Montana. Altitude of this range varies from about 6,250 to approximately 8,000 feet. Precipitation during May was 1.76 inches, slightly higher than the average for the preceding three years. However, vegetative development was later than normal because of the cool spring. June and July were drier than usual resulting in short growth and early curing of the main forage grasses, Idaho fescue and bluebunch wheatgrass, especially at the lower elevations. August precipitation was 3.14 inches, much higher than the average, but most forage species had already dried up at the lower elevations so there was little effect on summer growth. Snow came early. Several falls occurred in September and permanent snow fell in late October.

Except for being driven occasionally to the higher elevations where forage was more lush and abundant, the cattle were not handled during the entire summer. However, flies were troublesome in July causing the cattle to "brush-up" in the aspen groves during most days. As a result, grazing was done mainly during the early morning or late afternoon and evening hours. Perhaps the fly menace might have been reduced and the daily grazing period thereby lengthened had the cattle been sprayed with a suitable insecticide. Good results from spraying have been reported by numerous operators. Salt was available at several well distributed locations throughout the summer.

On September 29, after four months on the range, 73 head of cows, heifers, and steers were removed from the range and the balance, plus the calves born during the summer, remained until October 29. Thus the weights recorded for the various classes of cattle on June 1, September 29, and October 29 and presented in Table 1 provide some basis for evaluating seasonal fluctuations of mixed cattle run on Idaho fescue-bluebunch wheatgrass, national forest summer range in southwestern Montana.

Table 1. Average initial and final weights and changes in weight of mixed cattle run on the Vigilante Experimental Range during the 1951 grazing season

	Cows	Mixed 2-yr. olds	Mixed yearlings	Mixed calves	Summer calves*
Initial weight	848.8	617.4	426.2	177.1	-
Final weight	986.5	718.1	721.9	344.9	246.8
Gain	137.7	100.7	295.7	167.8	-
Percent gain	16.2	16.3	69.4	94.7	-

*Born in pasture, hence no entering weights or gains were obtained.

It can be readily seen that calves and yearlings made the largest gains. Yearlings showed the largest weight increase, nearly 300 pounds, while the two-year-olds showed the least, only 101 pounds. Calves made the largest percentage gain, 95 percent or almost double their initial weight; while the cows and two-year-olds were the lowest with almost identical increases of 16.2 and 16.3 percent, respectively.

Cattle marketed off the range at the end of September weighed considerably more than did the average for their class when put on the range, Table 2. Steers gained an average of 303, heifers 306, and dry cows 327 pounds. This gain in weight represents the increase in value of the marketed animals from the time they went on the range until they were taken off. Prices shown were the actual rates received by the owner when the cattle were weighed off the range. Cattle used in this study were not individually identified, therefore, a limited number of young animals may have been classed differently at the close of the season than they were at the beginning. Considering the prices received for marketed cattle and the total season-long change in weight of all animals grazed, the 4,000-acre Vigilante Experimental Range, moderately stocked, produced slightly more than $18,000 worth of beef during a five-month period this year.

Table 2. Average weight gained and value of gain at market prices of cattle run on the Vigilante Experimental Range in 1951

	One- and two-yr. old steers	One- and two-yr. old heifers	Fat, dry cows
Initial weight (pounds)	458.3	467.5	729.9
Market weight (pounds)	761.2	773.8	1,056.7
Gain (pounds)	302.9	306.3	326.8
Value of weight gain*	$99.96	$85.36	$87.43

*Based on 33 cents, 28 cents, and 24 cents per pound, live weight, for steers, heifers, and fat cows, respectively, paid by cattle buyers at the Three Forks Cow Camp on the Upper Ruby River.

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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

Volume III, Number 12 June 15, 1951

Prepared in the Division of Range Research

Another New Range Weed in Idaho: E. W. Tisdale and L. C. Erickson, College of Agriculture, University of Idaho, report that several thousand acres of range in the Weiser-Midvale region of Idaho and patches in the Mountain Home area are now covered by Medusa wild rye, a small annual grass of very low value. This plant, an immigrant from Europe, is known to occur in Washington, Oregon, and California but is so new to Idaho that according to the literature it has been collected only once.

Medusa wild rye is a vigorous growing annual grass, capable of producing abundant seed and is unpalatable to livestock. Under certain conditions it appears able to crowd out cheatgrass but is definitely poorer than cheatgrass as range forage. The plant appears to be spreading fast in the Idaho range country. Proven control measures are unknown, but spraying with herbicides, summer burning, or tillage followed by reseeding to a hardy perennial grass such as crested wheatgrass seem the most logical. Tisdale and Erickson caution to be on the alert for this noxious plant and warn that in the future it could become as serious a menace as halogeton. -- The News Letter, College of Agriculture, University of Idaho, 35:1,4. February 1950.

Grazing Value of Reseeded Grasses: Sheep grazing tests conducted at the Wyoming Agricultural Experiment Station over an 8-year period by O. K. Barnes have shown that crested wheatgrass and alfalfa were best for spring use and Russian wild rye best for summer and fall. Alfalfa added about one-third to the grazing capacity of crested wheatgrass.

One acre of crested wheatgrass carried as many animals and produced as much gain as 2.4 acres of native range. It produced 89 pounds of lamb gain per acre as compared with 29 pounds on native range. Alfalfa added to crested wheatgrass in 35-inch rows produced 96 pounds of lamb gain per acre.

Bluestem or western wheatgrass, an important native range species, averaged about 25 percent lower in grazing capacity than crested wheatgrass. Russian wild rye compared favorably with bluestem. It was preferred by the sheep, especially in summer, fall, and winter.

A combination of species developed by the Wyoming studies which gave excellent results was crested wheatgrass for spring grazing, bluestem wheatgrass for summer, and Russian wild rye for fall and winter. For 100 ewes with lambs the acreage needed would be 28 acres of crested wheatgrass from mid-April to early

June; 40 acres of bluestem wheatgrass through early summer, and 160 acres of Russian wild rye to December 1.

In these tests mixtures intended to provide palatable species throughout the season failed. To assure yearlong grazing the Wyoming experimenters found that it paid to use separate pastures for each species. -- From "Country Gentleman," May 1951.

Reseeded Species Compared: Cattle grazing tests conducted at the Manitou Experimental Forest in Colorado with pure stands of three reseeded species and a mixture of three, have shown what can be expected from these species in herbage and beef production.

Species and year	Herbage yield pounds/acre	Total cattle gains pounds/acre
Smooth brome		
1949	1,308	84
1950	669	35
Crested wheatgrass		
1949	2,091	98
1950	1,070	50
Mixture*/		
1949	2,585	126
1950	1,018	60
Intermediate wheatgrass		
1949	1,566	-
1950	1,769	84

*/ Smooth brome, crested wheatgrass, and yellow sweetclover.

All the species but intermediate wheatgrass produced less herbage in 1950 than in 1949 due to drought. This indicates that intermediate wheatgrass may have natural ability to produce more efficiently during dry years. -- From 1950 Annual Report, Rocky Mt. F&R Experiment Station, Fort Collins, Colorado.

Weaning Weight Related to Several Production Factors: The weaning weight of a calf is affected to some extent by its birth weight and the spring weight of the dam, and is materially affected by the age of dam and rainfall during the growing season, as shown in studies at the United States Range Livestock Experiment Station, Miles City, Montana. Two-year-old heifers, for instance, produced calves weighing 310 pounds, on the average, at 180 days of age, whereas 6-year-old cows weaned calves weighing 395 pounds at 180 days of age. There was a slight reduction in the size of weanling calves from 6-year-old cows to 10-year-old cows and a very rapid reduction in size after the cows reached 10 years of age.

On the average, the weaning weights of calves from cows of all age groups decreased 17 pounds for each inch decrease in rainfall below $7\frac{1}{2}$ inches during the growing season, April through September. However, there was more decrease in weaning weight when rainfall was less than 5 inches than between $7\frac{1}{2}$ and 5 inches. There was only $\frac{1}{2}$ pound increase with each additional inch of rainfall above $7\frac{1}{2}$ inches. -- From "Report of the Chief of the Bureau of Animal Industry, 1950."

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MISSOULA, MONTANA

Volume III, Number 13 July 1, 1951

Prepared in the Division of Fire Research

Sunday is the leading day for man-caused fires. A study of over 5,000 man-caused fires in the national forests of Region 1 shows that more fires start on Sunday than on any other day of the week. Monday is the next worst day, but is well behind Sunday in man-caused fire occurrence.

There is little difference in man-caused fire occurrence on other days of the week, with Friday having the third highest rating and Tuesday the lowest. The study also shows that man-caused fires are more numerous during every day of the week in August than in any other month. A 15-year summary of man-caused fires by day of the week is shown in the following tabulation:

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
No. of fires	1,071	810	693	718	701	732	724
Percent	19.6	14.9	12.7	13.2	12.9	13.4	13.3

Are snags a fire problem? For many years firefighters have singled out snags as troublemakers. A recent study of nearly 12,000 fires in the national forests of Region 1 indicates that the fear of snags is warranted. More forest fires start in snags than in any other fuel component. Over 34 percent of all fires in Region 1 originate in snags. On the other hand, less than 10 percent of the fires start in green tree tops. Obviously green trees generally outnumber snags in northern Rocky Mountain forests. But in spite of this numerical superiority snags hold over a 3-to-1 edge as a breeding ground of fires. The study showed that the highest percentage of snag fires occur in the grand fir type, with the white pine and subalpine types in second and third positions, respectively. The smallest percentage of snag fires occur in the ponderosa pine type. Occurrence of 11,835 fires according to material first ignited is shown in the following tabulation:

	No. of Fires	Percent of Total
Aerial fuels		
Snags	4,074	34.4
Green tree top	1,155	9.8
Moss on tree	399	3.4
Sub-total	5,628	47.6
Ground fuels		
Duff on ground	3,524	29.8
Wood on ground	1,361	11.5
Grass and weeds	920	7.7
Slash	300	2.5
Brush	102	0.9
Sub-total	6,207	52.4
GRAND TOTAL	11,835	100.0

Fire suppression crews are important. Studies of nearly 11,000 fires in the national forests of Region 1 show that only 4 percent of the fires required action by crews of more than 15 men. The remaining 96 percent were handled by smokechasers or small crews. However, the 4 percent of the fires requiring large crew action included 49.2 percent of the total fire perimeter handled by the suppression forces. An annual average of over 12,000 chains, or 150 miles, of fire perimeter involved large crew suppression action. The study showed when and where large crews are most likely to be required. As burning index increases, the need for large crews increases. At a burning index of 20 less than 20 percent of the total fire perimeter in the region requires large crew action. At a burning index of 80 over 70 percent of the fire perimeter requires large crew action. Similarly, as fuels become tougher, the requirements for large crews increase. In fuels classified medium-medium or less, only 39 percent of the total fire perimeter requires action by large crews; but in fuels rated higher, an average of 65 percent of the total perimeter requires such action. These facts emphasize the importance of organizing and training suppression crews or of preparing for the employment of their principal substitute -- the bulldozer unit.

Rain that does not affect fires. Rain during the fire season is a blessing, but a blessing whose magnitude can easily be overestimated. Many a smokechaser has become soaked while traveling through open country and thereby lulled into a false sense of security, only to be rudely awakened by the enthusiastic behavior of a fire which apparently hadn't heard about the rain. The reason is that quite a lot of our precipitation never reaches the ground. Data presented by Kittredge1/ show that the forest types of the northern Rocky Mountains intercept 8 to 43 percent of

1/ KITTREDGE, JOSEPH. Forest influences. McGraw-Hill Book Company, 1948. Chap. XI, pp. 99-114, esp. figure 12 and table 18.

the total precipitation during the growing season. Interception varies inversely as the amount of precipitation in each storm. Showers of up to 0.04 inch may be completely intercepted by an unbroken forest canopy, while 55-75 percent of a 0.20-inch rain will probably reach the ground.

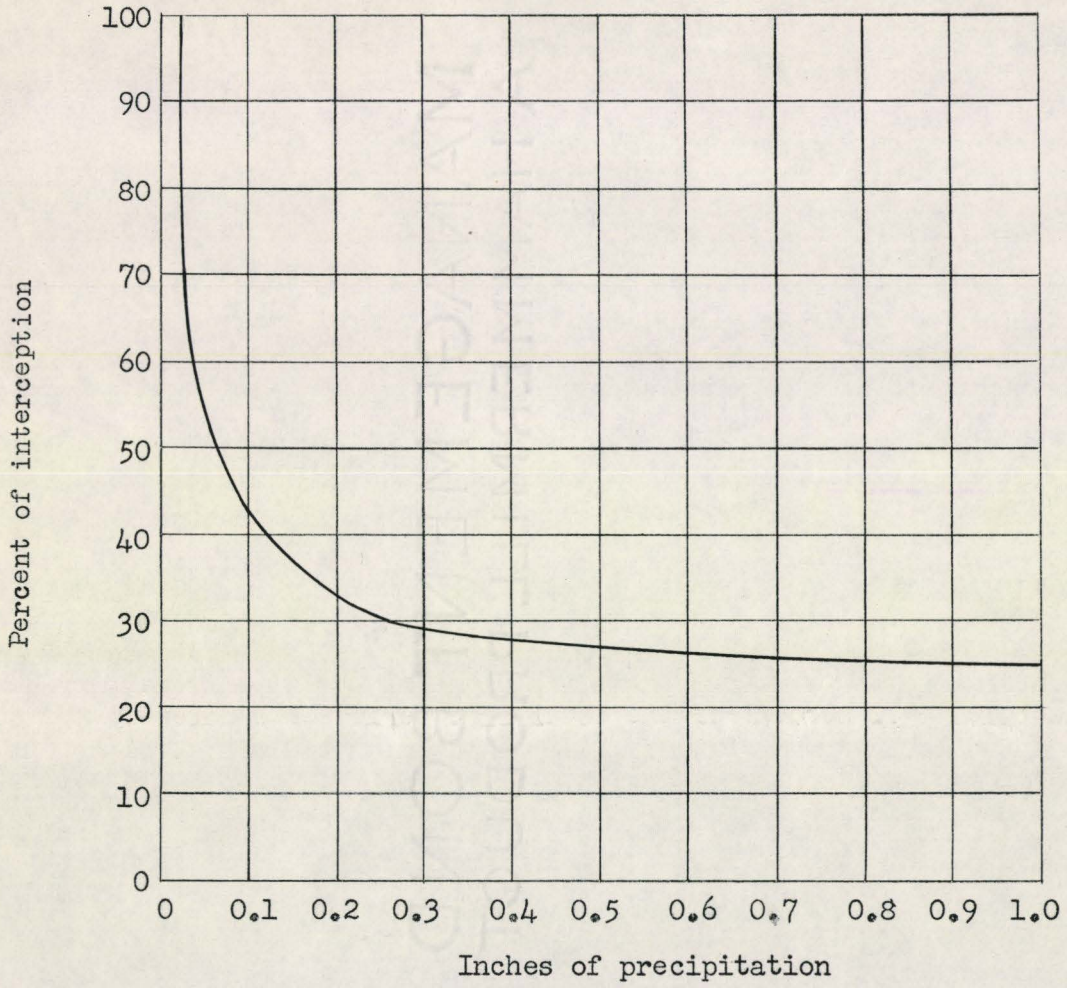

Figure 1. Percentage interception in relation to precipitation per shower. Generalized for conifer forests.

The importance of interception to fire control in Region 1 becomes apparent from analysis of precipitation per shower during July and August 1950. During this exceptionally wet summer, 26 percent of all showers brought 0.01 inch of rain or less, 47 percent 0.05 inch or less, 60 percent 0.10 inch or less. Thus it appears that about one shower in every three produces too little rain to reach the fuels beneath a heavy canopy. Indications are that perhaps another third of the summer storms do not get enough rain through the canopy to moisten fuels significantly. Thus after a summer rain the normal order of fire behavior will usually be reversed for a time, with fires in green timber more active than those in burns and logged-off areas. And at such times the behavior of fires in the timber has a good chance of surprising firegoers, dispatchers, and unwary overhead.

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MISSOULA, MONTANA

Volume III, Number 14 July 15, 1951

Prepared in the Division of Range Research

Utilization of Sagebrush and of Grasses Growing Within Pricklypear Clumps: Drought of considerable consequence occurred in the locality of Miles City and other parts of the northern Great Plains during 1949 and only scanty range herbage was produced, mostly from snowmelt moisture. Heavily stocked experimental cattle ranges at the United States Range Livestock Experiment Station near Miles City which normally provide around 135 animal unit months of grazing for breeding cows and spring calves from mid-May through late October or early November, furnished only 46 animal unit months up through August 4 in 1949. At that time the cattle were removed because of their poor condition resulting from scarcity of forage. This situation provided an opportunity to observe utilization of certain species under summer conditions and following near maximum grazing pressure and to compare use on companion pastures which were stocked at intermediate and light levels during the same season.

Browsing of big, silver, and fringed sagebrush (Artemisia tridentata, cana, and frigida) was nil or at least negligible on all pastures in 1949. Over-all pasture sampling showed that only one percent of the bushes of silver sagebrush were browsed and those but lightly in the lightly stocked pastures. None of the other species in these pastures were browsed. All three species were entirely ungrazed in the other pastures. This was true even though the chief forage grasses in the heavily stocked pastures had been almost completely utilized by the cattle and grasshoppers. For example, of the two grasses which provided a substantial amount of cattle forage that year, 93 percent of the bluestem wheatgrass (Agropyron smithii) stems were grazed to an average stubble of 2.2 cm., and 90 percent of the needleandthread (Stipa comata) grass bunches were half or more grazed to an average stubble of 1.8 cm.

This circumstance is in contrast to the remark heard occasionally that cattle will make considerable use of sagebrush, particularly silver sagebrush, during drought periods. Sarvis in North Dakota (USDA Bulletin 1170) noted considerable use of fringed sagebrush on heavily stocked pastures during the drought of 1917 after other herbage became scarce; but apparently cattle must be under considerable pressure of starvation before they take any of these species in substantial amounts during the summer months.

Use of these shrubs under fall and winter conditions, however, may be a different matter. In most years, cattle on the experimental ranges have taken small

amounts of silver sagebrush out of preference during late fall and winter even though a good supply of other forage was available. During the relatively normal winter of 1944-45 fourteen and sixteen percent of the silver sagebrush bushes on the heavily and intermediately stocked experimental winter range were browsed to some extent. Coupland in Canada (Ecological Monographs 20: 271-315, Oct. 1950) has also reported considerable use of fringed sagebrush on winter range. Explanation of this difference in seasonal use perhaps may lie partly in chemical changes in the plants themselves relative to season. To our knowledge, this aspect has never been investigated.

The relation of grazing pressure to utilization of palatable forage grasses growing within pricklypear cactus clumps which were presumed to be a deterrent to grazing was also investigated on the experimental summer ranges in 1949. Bluestem wheatgrass and the needlegrasses, needleandthread and green needlegrass (Stipa viridula), combined, were observed and only those portions of plants above the cactus judged to be available to the cattle were considered. Care was taken to include only livestock grazing. Results of the survey are tabulated below:

PERCENTAGE OF PRICKLYPEAR CLUMPS IN WHICH BLUESTEM WHEATGRASS AND THE NEEDLEGRASSES WERE GRAZED, 1949

Item	Stocking intensity	
	Heavy	*Conservative
Bluestem wheatgrass:		
Less than 50% of stems grazed.....	45	9
50% or more of stems grazed.....	29	8
TOTAL.....	74	17
Needlegrasses:		
Less than 50% of total area grazed....	7	28
50% or more of total area grazed.....	93	50
TOTAL.....	100	78

*Intermediate and light combined.

Considerably heavier use was made of the grasses growing within pricklypear clumps on the heavily stocked pastures than on pastures stocked more conservatively. This was particularly true of bluestem wheatgrass, and to a lesser degree of the needlegrasses. Pasture-wide utilization of herbage in all pastures, even those stocked more conservatively, was much heavier in 1949 due to drought conditions than during more normal years. Approximately 80 percent of the bluestem wheatgrass and needleandthread plants growing outside the cactus were grazed to average stubbles of 3 and 2.5 cm., respectively, on the conservatively stocked pastures compared to approximately 90 percent with average stubbles of 2.2 and 1.8 cm., respectively, on the heavily stocked pastures. Despite these small differences, partly protected bluestem wheatgrass and needlegrass growing within pricklypear clumps were grazed in considerably fewer of the cases on the more conservatively stocked pastures suggesting that grazing of such protected grasses increases considerably after grazing pressure reaches a rather heavy level. The percentage of pricklypear clumps within which these grasses were grazed on the conservatively stocked ranges under conditions in 1949 probably is maximum or excessive for conservative stocking. Heavier use of these grasses within pricklypear clumps on northern Great Plains ranges would probably signify excessively heavy grazing pressure. Greater proportional use of the needlegrasses than bluestem wheatgrass may reflect in part their bunch growth-form which seemingly would afford a larger bite to a grazing animal than the separate and relatively dispersed stems of the latter. -- NRM F&R Experiment Station release.

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MISSOULA, MONTANA

Volume III, No. 15 August 1, 1951

Big Drop in Pole Production During 1950. Production of transmission poles in the Northern Rocky Mountain Region dropped from 599,000 in 1949 to 390,000 in 1950. Less than half as many poles were produced in 1950 as in the peak year of 1947. The interesting point in comparing the 1947 and 1950 production figures is that cedar poles, the long time favorite, have pretty well held their own. On the other hand, lodgepole pine and larch pole production has fallen off 71 percent since 1947. Only in recent years have these species been used for poles to any extent. They are very suitable for that purpose but have yet to establish themselves firmly in a highly competitive market. -- Northern Rocky Mountain Forest and Range Experiment Station Research Note 101, June 1950.

One-quarter Cord Per Acre Per Year. Recent events which suggest that there may be a greatly expanded forest industry development east of the Continental Divide in Montana raise the question of the sustained yield capacity of the forests in that area. An analysis of four million acres of the commercially most attractive part of this forest indicates that a net annual cut of one-quarter cord per acre per year can be maintained. This figure takes into account reductions in yields that might result from special management measures to protect watersheds and waste and incomplete utilization in logging operations. There is, of course, a wide variation between different types and different localities. Following is the allowable cut per acre by type in Beaverhead County before making reductions for the factors previously mentioned.

Type	Allowable cut per acre Cords
Alpine fir	.3
Douglas-fir	.1
Spruce	.6
Lodgepole pine	.4
White bark and limber pine	.2
Aspen	.3

Prepared by the Division of Forest Economics

Slope Correction Factors. The measurement of uniform-size plots on sloping ground involves adjustment for variation between slope and horizontal distances. The appropriate slope distance (for slope expressed in percent) can be derived by multiplying horizontal distances by the factors shown below. For example, on a 20-percent slope a horizontal distance of 50 feet is equivalent to a slope distance of 50 x 1.0198 or 50.99 feet.

Percent slope	Factor	Percent slope	Factor	Percent slope	Factor
4	1.0008	52	1.1271	82	1.2932
8	1.0032	54	1.1365	84	1.3060
12	1.0072	56	1.1461	86	1.3189
16	1.0127	58	1.1560	88	1.3321
20	1.0198	60	1.1662	90	1.3454
24	1.0284	62	1.1766	92	1.3588
28	1.0385	64	1.1873	94	1.3724
32	1.0500	66	1.1982	96	1.3862
36	1.0628	68	1.2093	98	1.4000
40	1.0770	70	1.2207	100	1.4142
42	1.0846	72	1.2322	104	1.4428
44	1.0925	74	1.2440	108	1.4718
46	1.1007	76	1.2560	112	1.5015
48	1.1092	78	1.2682	116	1.5315
50	1.1180	80	1.2806	120	1.5620

If greater range or more refinement is required, additional factors can be calculated from the formula: $\text{Factor} = \sqrt{1 + (\text{slope percent, expressed as a decimal})^2}$

Lodgepole Saw-timber stands - Gallatin National Forest. Based on 80 Forest Survey sample plots the average acre composition in trees 5.0" d.b.h. and larger is shown in the following table:

D.B.H.	Lodgepole pine			Other species			All species		
	Trees	Volume 1/		Trees	Volume 1/		Trees	Volume 1/	
		Cu.ft.	Bd.ft.		Cu.ft.	Bd.ft.		Cu.ft.	Bd.ft.
5.0" - 10.9"	75	552	--	65	342	--	140	894	--
11.0" - 20.0"	43	1212	6934	9	299	1663	52	1511	8597
Over 20.0"	0.1	5	30	1	78	506	1.1	83	536
Total	118.1	1769	6964	75	719	2169	193.1	2488	9133

1/ Cubic-foot volume is net volume inside bark of trees 5.0" d.b.h. and larger from stump to 4" top. Board-foot volume is net volume, International 1/4" rule, of trees 11.0" d.b.h. and larger to 6 - 10" top.

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MISSOULA, MONTANA

Volume III, Number 16 October 1, 1951

Survival of seed-spotted lodgepole pine. The 11-acre lodgepole pine direct seeding on the Lewis and Clark National Forest, which was planted in June 1950, experienced only small losses during the winter and second growing season and can still be classed as a successful plantation. At the end of the first growing season, 75 percent of the seed spots contained one or more seedlings each. Twelve months later, sixty-seven percent of the seed spots were stocked. At the end of the second growing season, stocked spots averaged slightly over two seedlings each. The maximum number of trees in a single spot was 11. By way of comparison, the row of 100 nursery-grown 1-1 transplants placed in the same area contained 98 live trees at the end of the second growing season. The planted trees are appreciably taller.

Farm woodland test-demonstration plots. During the field seasons of 1950 and 1951, one of the major projects of the Inland Empire Research Center has been installation of five series of intermediate harvest cutting plots in second-growth ponderosa pine. The plots are designed to demonstrate and measure the results of good and poor cutting practices in farm woodlands. The plots are located on farms and other small land holdings and Indian Reservation land in eastern Washington and north Idaho.

In each set of plots one was marked for cutting to a diameter limit similar to the "chopper's choice" type of cutting so prevalent in second-growth stands today. Diameter limit cutting, of course, gives the largest immediate return but depletes the growing stock badly. On a second plot in each group the timber was marked for an improvement cut. Stand improvement marking generally has removed only 25 to 30 percent of the volume. A third plot is left uncut, but is paint marked for demonstrational purposes to illustrate the light cut.

Logging has been completed on two of the five series of plots. One series is located on the William F. Eastman ranch near Chewelah, Washington. The other is situated on the Spokane Indian Reservation. On Mr. Eastman's farm, loggers had offered $5.00 per thousand board feet for his timber on an estimated volume of 100,000 board feet. Under the common lump sum type of timber purchase, a stumpage buyer would have paid $500 for the timber and then cut everything that was merchantable.

Under the arrangement with the Experiment Station, by which Mr. Eastman allowed marking and cutting according to the plan for the study, he sold 145,000 board feet for $1450 and he still has a reserve stand containing 250,000 board feet.

Prepared in the Division of Forest Management Research

Winter injury to lodgepole pine hybrids. The hybrid lodgepole X jackpine in the field test on the Lewis and Clark National Forest have suffered severe winter or frost injury. The trees, which were field planted as 1-1 seedlings in June 1950, were observed to have injured terminal shoots when examined in June 1951. Data on condition in August 1951 are shown below:

Kind of tree and origin	Healthy	Dead	Dead terminal shoot
	(Number)	(Number)	(Number)
Hybrid (from lodgepole, California, and jack pine, Wisconsin)	2	3	5
Jack pine (Minnesota)	5	2	3
Lodgepole pine (California)	10	0	0
Lodgepole pine (south central Montana)	10	0	0
Lodgepole pine (western Montana)	9	0	1

Trees in replicates of this test in western Montana and north Idaho did not experience similar injury.

# # # # # # #

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MISSOULA, MONTANA

Volume III, Number 17 October 15, 1951

Prepared in the Division of Range Research

Experimental Cattle Weights Summer 1951: Individual weight records of Hereford cows and calves run on native short-grass ranges at three rates of stocking have again demonstrated some of the advantages of conservative range use. The experimental cows now four years old and with their second crop of calves at side have been run on short-grass range at the same three levels of stocking - heavy, moderate, and light - since they were yearlings. When started as yearlings, the three lots were balanced as to ancestry, age, and average weight.

Summary of Cow Weights Mid-May to Early September 1951

Stocking intensity	May 17	June 14	July 12	August 9	September 6
Heavy	895.9	900.1	950.2	968.2	907.8
Moderate	918.4	952.7	1,000.7	1,038.4	1,030.6
Light	951.3	1,010.9	1,061.2	1,097.2	1,069.8

In mid-May 1951, the beginning of the fourth summer grazing season, cows on moderately and lightly stocked range averaged 23 and 55 pounds heavier, respectively, than cows of the same age on heavily stocked range. By early August when the seasonal peak in weight was reached by all lots the spread had increased to 70 and 129 pounds, respectively. Even though a decline in average cow weight occurred in all lots after the early August peak was reached, the weight differences between stocking intensities continued to increase. Four weeks after the seasonal peak was recorded cows on moderately and lightly stocked range averaged 123 and 162 pounds heavier, respectively, than those on heavily stocked range. This weight trend indicates two important points. First, the larger cows on moderately and lightly stocked range gained more weight to their peak for the season than did those under heavy stocking - 112 and 118 pounds, respectively - as against 72 pounds per cow. Secondly, after the peak weight was reached cows on moderately and lightly stocked range lost weight less rapidly than those under heavy stocking. Aside from the simple arithmetic of beef production which now is universally important the greater weight gain and better retention of weight with conservative stocking means better cattle and a lighter wintering load. Stockmen everywhere, but especially in the northern Great Plains, know the importance of these factors in their operations.

parated on a wet and dry basis the cows showed the same trend in weight and as great or greater weight differences between intensities. For example, dry cows from moderately and lightly stocked range averaged 174 and 239 pounds heavier in early September

than dry cows from heavily stocked range. For the wet cows the weight advantages in early September under moderate and light stocking were 111 and 149 pounds over heavy stocking. The proportion of dry cows was greater under heavy stocking. This eliminates the possibility of the weight differences being due to more heavy dry cows on moderately and lightly stocked ranges.

Trends in calf weights for the summer season support this picture of cow weights. In mid-June calves on moderately and lightly stocked range were 19 and 20 pounds heavier

Summary of Average Calf Weights, 1951

Stocking intensity	June 14	July 12	August 9	September 6
Heavy	158.7	211.5	264.7	304.8
Moderate	177.7	223.2	277.6	331.9
Light	178.5	232.0	291.6	339.6

than calves on heavily stocked range. By early September these advantages had increased to 27 and 35 pounds, respectively. During the 84-day period, average weight gains made by range calves were 146, 154, and 161 pounds under heavy, moderate, and light range stocking. In terms of pounds per calf per day these gains average 1.73, 1.82, and 1.91. With six to eight weeks to go before weaning it is rather certain that conservative stocking this year will show even greater advantages than these in terms of cows and calf weights over heavy stocking. -- NRM F&R Experiment Station release.

Salt Use by Range Cattle: During the past summer, May 17 through September 5, 60 breeding cows with calves on experimental native ranges near Miles City, Montana, used a total of 419 pounds of salt. This was an average of 1.88 pounds of salt per cow per month. Granulated stock salt without minerals added was supplied free choice. The rate of use was approximately 2.5 times the average level of consumption of a 3:1 salt-bonemeal mixture fed during the same summer period from 1940 through 1944.

Although salt use was higher throughout the 1951 summer season than in the 1940-1944 period it followed a similar pattern in relation to season. Seasonal trend of salt-bonemeal consumption during the earlier period was given in Hi-Lites, volume II, number 11. From mid-May to mid-June, 1951, salt use averaged 0.96 ounces per cow per day; from mid-June to mid-July, the average dropped slightly to 0.80 ounces and remained at this level for the next period ending in early August; from early August through early September, average consumption increased to 1.44 ounces per cow per day.

Greater use of salt during the 1951 season than of salt-bonemeal mixture during the 1940-1944 period may have been caused by both poorer forage conditions and provision of straight salt without other minerals. Forage conditions in 1951 compared to the earlier years were only fair. Although the short grasses made fair growth, the midgrasses were stunted due to inadequate spring moisture and a considerable part of the cattle forage throughout the 1951 season probably was made up of old growth pretty well leached of minerals. Such a low-mineral diet probably would create a greater demand by cattle for supplemental minerals throughout the season and particularly during late summer after growth was mature and curing. Traces of calcium and phosphorus in the straight salt furnished might have led to greater salt consumption in an effort to compensate for inadequate amounts of these minerals in the forage, as well as perhaps also greater than normal demand for other minerals supplied by the salt. Kennedy (Fred H., Amer. Hereford Journal, December 15, 1935) reported increased consumption of both straight salt and bonemeal, when fed separately, by cattle on these ranges in 1934. It seems improbable that loss through weathering was much of a factor in the heavier use in 1951 since precipitation during this period was relatively sparse and poorly distributed. -- NRM F&R Experiment Station release.

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MISSOULA, MONTANA

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December 18, 1951

Prepared in the Division of Range Research

Weights of Cattle On Experimental Range: Weights and gains of cattle on national forest summer ranges are seldom systematically recorded, therefore, little information is available concerning this important subject. The following record was obtained during the 1951 grazing season on the Vigilante Experimental Range.

On June 1, the beginning of the grazing season, 162 head of mixed cattle were weighed and placed on the Vigilante Experimental Range located on the Upper Ruby River in southwestern Montana. Altitude of this range varies from about 6,250 to approximately 8,000 feet. Precipitation during May was 1.76 inches, slightly higher than the average for the preceding three years. However, vegetative development was later than normal because of the cool spring. June and July were drier than usual resulting in short growth and early curing of the main forage grasses, Idaho fescue and bluebunch wheatgrass, especially at the lower elevations. August precipitation was 3.14 inches, much higher than the average, but most forage species had already dried up at the lower elevations so there was little effect on summer growth. Snow came early. Several falls occurred in September and permanent snow fell in late October.

Except for being driven occasionally to the higher elevations where forage was more lush and abundant, the cattle were not handled during the entire summer. However, flies were troublesome in July causing the cattle to "brush-up" in the aspen groves during most days. As a result, grazing was done mainly during the early morning or late afternoon and evening hours. Perhaps the fly menace might have been reduced and the daily grazing period thereby lengthened had the cattle been sprayed with a suitable insecticide. Good results from spraying have been reported by numerous operators. Salt was available at several well distributed locations throughout the summer.

On September 29, after four months on the range, 73 head of cows, heifers, and steers were removed from the range and the balance, plus the calves born during the summer, remained until October 29. Thus the weights recorded for the various classes of cattle on June 1, September 29, and October 29 and presented in Table 1 provide some basis for evaluating seasonal fluctuations of mixed cattle run on Idaho fescue-bluebunch wheatgrass, national forest summer range in southwestern Montana.

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Table 1. Average initial and final weights and changes in weight of mixed cattle run on the Vigilante Experimental Range during the 1951 grazing season

	Cows	Mixed 2-yr. olds	Mixed yearlings	Mixed calves	Summer calves*
Initial weight	848.8	617.4	426.2	177.1	-
Final weight	986.5	718.1	721.9	344.9	246.8
Gain	137.7	100.7	295.7	167.8	-
Percent gain	16.2	16.3	69.4	94.7	-

*Born in pasture, hence no entering weights or gains were obtained.

It can be readily seen that calves and yearlings made the largest gains. Yearlings showed the largest weight increase, nearly 300 pounds, while the two-year-olds showed the least, only 101 pounds. Calves made the largest percentage gain, 95 percent or almost double their initial weight; while the cows and two-year-olds were the lowest with almost identical increases of 16.2 and 16.3 percent, respectively.

Cattle marketed off the range at the end of September weighed considerably more than did the average for their class when put on the range, Table 2. Steers gained an average of 303, heifers 306, and dry cows 327 pounds. This gain in weight represents the increase in value of the marketed animals from the time they went on the range until they were taken off. Prices shown were the actual rates received by the owner when the cattle were weighed off the range. Cattle used in this study were not individually identified, therefore, a limited number of young animals may have been classed differently at the close of the season than they were at the beginning. Considering the prices received for marketed cattle and the total season-long change in weight of all animals grazed, the 4,000-acre Vigilante Experimental Range, moderately stocked, produced slightly more than $18,000 worth of beef during a five-month period this year.

Table 2. Average weight gained and value of gain at market prices of cattle run on the Vigilante Experimental Range in 1951

	One- and two-yr. old steers	One- and two-yr. old heifers	Fat, dry cows
Initial weight (pounds)	458.3	467.5	729.9
Market weight (pounds)	761.2	773.8	1,056.7
Gain (pounds)	302.9	306.3	326.8
Value of weight gain*	$99.96	$85.36	$87.43

*Based on 33 cents, 28 cents, and 24 cents per pound, live weight, for steers, heifers, and fat cows, respectively, paid by cattle buyers at the Three Forks Cow Camp on the Upper Ruby River.

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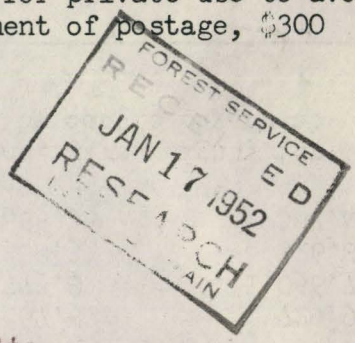

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

December 1952

PULP MILL SITES IN EASTERN MONTANA IN RELATION TO EFFECTS ON WATER QUALITY OF THE UPPER MISSOURI AND YELLOWSTONE RIVERS 1/

By

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Washington, D.C.

The following report summarizes information obtained in a preliminary study of pulp mill sites that have been suggested for development in the State of Montana east of the Continental Divide, considered from the point of view of possible effect of effluents on water quality in the Upper Missouri River and Yellowstone River Basins. The reconnaissance survey of contemplated sites, made at the request of the State Board of Health, was conducted during the period, August 6-10, 1951. Sites covered were in the vicinity of Billings and Livingston along the Yellowstone River, and Three Forks, Winston, and Great Falls along the Upper Missouri River. The Forest Service, Missoula office, U. S. Department of Agriculture, the Montana State Chamber of Commerce, as well as the State Board of Health, and other Federal, State and local agencies, are interested in the proposal to build pulp mills in the area, and participated in visits to sites considered or attended meetings and conferences arranged as a part of the survey. Subsequent to the initial observations made and gathering of information started in Montana, supplemental data and material have been furnished by numerous individuals and agencies, which have been very helpful in studies conducted in preparation of this report. The findings from this survey are briefly as follows:

1/ In 1951 the Montana State Board of Health and the Forest Service invited Mr. Warrick to make a study of potential pollution problems on eastern Montana streams in relation to the development of a pulp industry. Several organizations and individuals cooperated in the study. The Northern Rocky Mountain Forest and Range Experiment Station is glad to make available its facilities in reproducing and distributing this report. A comment which follows the main report was prepared by the Montana State Board of Health and the Montana State Chamber of Commerce.

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Summary and Conclusions

1. The development of a wood pulping industry is being considered for the eastern portion of the State of Montana. Attention is being given to the possibilities of pollution arising from such a development.

2. Sites for pulp mills given attention are confined to the Yellowstone and Upper Missouri River Basins. Those now being considered are situated in the vicinity of Billings, Livingston, Three Forks, Winston, and Great Falls, Montana.

3. The method of wood pulping contemplated for the proposed mills is the sulphate, or kraft, process. Other processes, however, are not excluded, but at present are not being given primary consideration.

4. The introduction of pulp mill wastes into a stream will have some effect on the character or quality of water in the stream. The important consideration is whether these changes will have a detrimental effect on the existing and desirable uses of the stream below the pulp mill and the extent or degree of the detrimental effects, if any, on such water uses.

5. The establishment of a 200 ton kraft pulp mill in the vicinity of Livingston will not result in depletion of dissolved oxygen below limits required for fish or other desirable aquatic life. At this site, it is possible that toxicity effects of the mill wastes may appreciably reduce the desirable fish populations for a limited distance below the mill. The mill effluent may necessitate appropriate treatment for removal of color, tastes, and odors from any public drinking water supplies that are obtained in the future from the Yellowstone for a short distance below Livingston. No present water supply will be affected. Effects on the esthetic quality of the stream will be limited to a very short sector of the stream below the mill. There should be no appreciable effect on the suitability of the water for irrigation. It is concluded from presently available information and data that Livingston is a less suitable site for a pulp mill than some of the others considered.

6. The combined effects of the very considerable amount of organic wastes now being discharged in the vicinity of Billings and the wastes from a 200 ton kraft pulp mill will deplete the dissolved oxygen concentration in the stream below that considered necessary for maintenance of a maximum desirable fish population. The effect the mill effluent would have on the appearance of the Yellowstone River and its suitability for irrigation and as a source of drinking water supply for any future developments downstream are similar to those described for Livingston. It is concluded that Billings is a relatively unsuitable site for the location of a pulp mill principally because of the considerable pollution load already being discharged to the stream in this vicinity.

7. The establishment of a 200 ton kraft pulp mill in the vicinity of Three Forks and discharging wastes below the junction of the three rivers forming the Missouri, should not reduce the dissolved oxygen in the stream below the concentration considered adequate for fish. Considering

dilution available and other factors, it is not expected that any toxic effects of the wastes will appreciably reduce the fish population in the stream. Color, taste and odor producing substances in the wastes may render the Missouri River from the mill to the Canyon Ferry Dam somewhat less satisfactory as a source for public drinking water supplies. Such supplies are not presently obtained from the river in this area. There will be no appreciable effect on the suitability of the water for irrigation. Impairment of the esthetic quality of the stream will be limited to the very short sector below the mill waste outlets. It is concluded from the available information and data that it appears feasible to establish a 200 ton kraft pulp mill at Three Forks without creating material pollution of the stream and that further consideration of this site is justified.

8. The effects on the stream of the effluent from a 200 ton kraft pulp mill located near Winston and discharging wastes into the Missouri River, a few miles upstream from the slack water of the Canyon Ferry Reservoir, should not vary materially from those described for the Three Forks site. It is concluded from the available information and data that the vicinity of Winston justifies additional consideration as a pulp mill site.Mills should not be established at both the Winston and Three Forks sites at the same time as the effect of the wastes on the waters will be cumulative to a considerable extent.

9. The establishment of a 200 ton kraft pulp mill near Great Falls should not appreciably reduce the desirable fish populations in the stream. The effluent might possibly increase color, taste, and odors in the Fort Benton water supply to the extent that additional treatment would be necessary. There should be no appreciable effect on the suitability of the river water for irrigation. Limited effects on the esthetic quality of the stream will exist only in a very short sector of the stream below the mill waste outlets. It is concluded from available information and data that Great Falls is a relatively suitable site for a kraft pulp mill and justifies additional consideration.

10. It is recommended that as a part of future planning for any pulp mill projects in Montana there be included complete stream surveys of those portions of the rivers that may be significantly affected by the wastes. The purpose of these surveys would be to determine as accurately as possible existing physical, chemical, biological and other factors that would govern mill production capacity in relation to waste disposal at each specific site.

The foregoing findings are the results of field observations and study which included (1) assembly and analysis of hydrologic, estimated waste discharge and available water quality data; and (2) correlation of collected information in terms of appropriate water quality objectives based on water use. The study necessitated the evaluation of future dissolved oxygen conditions in the Yellowstone and Upper Missouri Rivers, forecast under various drought probabilities with kraft pulp mills of 200 ton daily capacity located at the various sites along these streams; and consideration of the anticipated effects of the effluents on other stream characteristics related to present and certain possible future uses.

The importance of maintaining a high degree of cleanliness in the relatively unpolluted portions of the streams, and of providing for suitable utilization, treatment and disposal of existing and future pollutional wastes is recognized. Montana has a valuable asset in its cold, clear waters from snow capped mountain areas. These waters are already utilized for the benefit and enjoyment of both the citizens and visitors to the State. Accordingly, the essential problem is to conserve to the fullest extent possible the values of these waters for all purposes. (1) (2).

Timber Resource Suited for Pulpwood

The State has reasonable timber resources that it has had an increasing market for up to the present time, including pulpwood. This pulpwood, produced for the most part in South Central Montana, is now being exported to mills in the Midwest. There is a desire to utilize a substantial part of the potential pulpwood production of forest areas as a raw material for pulp manufacturing in the State.

The pulpwood available, including a considerable amount of deadwood in addition to the expected annual crop of green wood, is sufficient to very adequately support operations at several mills located East of the Continental Divide, this being the only area considered in this report. The kind of wood is quite suitable for pulping by the sulphate (kraft) process. Accordingly, this type of process is currently being given primary consideration.

Pulping Processes and Water Used

The sulphate, or kraft, process considered in Montana, consists essentially of digestion of wood chips under steam heat and pressure with sodium hydroxite -- sodium sulphide cooking liquor, or solution, to separate the cellulose fibers from the other organic material. The spent liquor remaining in the pulp after an initial draining is removed in modern mills with vacuum washers. It then is evaporated and burned for the recovery of chemicals and the fuel value of the dissolved organic material. The waste effluent from the mill carries small quantities of chemicals, dissolved organic solids and suspended fibers in the wash water.

Volumes per ton of pulp of process water needed in newer mills will usually range between 20,000 and 40,000 gallons. The waste produced will probably range in oxygen demand per ton of pulp from a population equivalent of 200 to 400, with carefully operated modern mills having effluents near the lower figures. In the studies made in Montana the higher of these as regards both volume and strength was used, introducing a factor of safety in the computations made in forecasting stream conditions.

Possibilities of Pollution Control

It should be pointed out also that an appreciable further allowance is made in appraising stream conditions with effluents to be anticipated from 200 ton kraft pulp mills by using the low river flows (computed from U.S.G.S. data), under both summer and winter conditions, that occur with a frequency of once in 10 years. These more critical conditions for dilution of mill effluents will be approached for only limited periods during each year.

Process and equipment improvements have resulted in a definite trend downwards in the volume and strength of unbleached kraft pulp and paper mill effluents. The strength of the wastes on an oxygen demand basis has been decreased as much as 75 percent by such improvements, with attendant reduction in chemical requirements. Monitoring equipment is proving of value in avoiding occasional increases in sewer losses. The work on waste reduction is nearing an irreducible minimum, however, and further reductions necessitate consideration of treatment and disposal methods.

Such measures for treatment and disposal as have been employed in recent years with kraft mill wastes, have been directed toward reduction of waste components toxic to fish life (3-5) as well as to reduction in oxygen demand. An example of a toxic waste stripping treatment method installed in kraft mills is the so-called Bergstrom tower process. It removes a large portion of toxic sulphides and mercaptans from the composite mixture of blow steam condensate, evaporator condensate, and digester relief condensate following separation of the turpentine which is usually marketed or burned.

Stream dilutions available at pulp mill sites considered in Montana indicate that there should be no appreciable effect on the quality of the waters for irrigation purposes. (6)

Lagooning has been utilized with beneficial results in reducing the strength of kraft mill wastes, and in equalizing the flow and variations to be expected in strength of mill wastes. The use of lagoons of suitable capacity for effluents, therefore, gives flexibility in handling of wastes to avoid objectionable conditions during periods of low stream flow (7-8) and highest water temperatures. Special studies in recent years to increase the efficiency of lagoons have been conducted by the Industry through their Council on Stream Improvement, and much information is available on performance of this method for treatment and disposal of kraft mill effluents.

Biological methods of treatment, similar to those currently used in sewage treatment practice, with the addition of nutrients to support the organisms involved, are currently being studied in pilot plants. Results with the activated sludge process at one mill have been quite impressive to date, giving a high degree of reduction of the oxygen demand. Further work will need to be carried out, however, before the process can be recommended for mill-scale application.

In conclusion the observations and studies indicated the more suitable sites of those suggested for the development of a kraft pulp industry in Montana, viewed from the point of view of probable effect of effluents, are on the Yellowstone and Upper Missouri Rivers. This preliminary survey should be followed by detailed evaluation of conditions when definite information is available covering individual mill projects. Suitable operation and treatment provisions can then be determined for each project to enable attainment of a high degree of stream cleanliness consistent with water uses.

Acknowledgments

The assistance of Mr. C. W. Brinck, Mr. H. B. Foote, and Mr. H. W. Taylor of the Division of Environmental Sanitation, Montana State Board of Health, in obtaining essential information and data used in this study is gratefully acknowledged.

The cooperation of the Missoula office, Forest Service, U.S. Department of Agriculture, in furnishing various facts relating to the contemplated pulp mill developments, especially the aid of Mr. I. V. Anderson, is acknowledged with appreciation. Mr. G. H. Chidester of the Forest Products Laboratory has provided valued assistance. The Montana Power Company, through Mr. R. C. Setterstrom, furnished hydrologic data and other helpful information. Acknowledgment is also made to the Bureau of Reclamation, Fish and Wildlife Service, and Geological Survey, Department of Interior, Federal Power Commission, and the Missouri Drainage Basin Office, Division of Water Pollution Control, Public Health Service, Federal Security Agency, for assistance rendered in obtaining data, for information from their published reports, and for comments and suggestions made covering water storage and irrigation, stream discharges, power projects, existing pollution, and other items relating to developments in the Yellowstone and Upper Missouri River Basins.

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Comment

by

Montana State Board of Health

and

Montana State Chamber of Commerce

In the preceding report, Warrick and Anderson have shown that the construction of pulp mills in eastern Montana is feasible from the standpoint of water supply. It has been brought out that some streams are sufficiently large to handle the wastes of proposed plants if reasonable care is given to the handling of the wastes.

Our present laws in Montana require that a stream not be polluted to such a point that it will affect the health of the people. The law does not attempt to protect any other water uses such as the use of the water for irrigation, for other industries, or for fish and wildlife. Before pulp mills do become established in Montana, we should have adequate legislation to protect our streams. Corrective laws that might be passed after plants have been constructed would be unfair to established industries and might require costly improvements in the plants--improvements that probably could have been made at minimum cost if the legislation had been on the books at the time the plant was constructed.

It is hoped that those interested in obtaining additional industry in Montana will recognize the necessity for proper legislation at this time, rather than wait until the streams in Montana have been damaged before corrective measures are instituted.

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

August 19, 1953

Salt use by cattle on winter range. Last winter, November 28, 1952 to May 15, 1953, 60 head of breeding cows on experimental native range near Miles City, Montana consumed a total of 374 pounds of salt. This was an average of 0.037 pounds per cow per day. Granulated salt, with no mineral added, was supplied free-choice in open boxes located about one-quarter mile from water. The cattle consumed 170 pounds more salt than was consumed during the same period the winter of 1951-52. Complete salting records are not available for the winter of 1950-51, but those for February 19 through May 17, 1951 show a total consumption of 123 pounds. For the same period in 1952 the total consumption was 148 pounds, and in 1953 it was 209 pounds. The daily consumption per cow for the three winter seasons was as follows:

Year	Average per Cow per Day (pounds)
1950-51	0.027
1951-52	0.020
1952-53	0.037

The increased use of salt during the 1952-53 season is probably due in part to the unusually mild winter which, with fairly high temperatures and very little snow, allowed the cattle to eat more salt than when the boxes were covered with snow and the salt frozen. This is illustrated by contrast with the 1951-52 record which shows that the first snow fell December 12, 1951 and remained on the ground throughout the winter. During the period November 29, 1951 to February 20, 1952, when the ground was covered with snow, the cattle consumed 108 pounds of salt. During the same period of 1952-53, when the ground was bare most of the time, they consumed 165 pounds. It may also be partially due to the fact that the spring of 1953 was unusually dry, leaving the cattle little to eat but cured forage from which most of the minerals had been leached. Another possibility is that when the ground is bare, or partially bare, the cattle are not inclined to stay around the winter feeding area, but will range out farther in the vicinity of the salt boxes.

Stocking rate affects winter feed requirements and cattle weights. In cattle grazing studies conducted near Miles City, Montana, last winter's feed records again showed that both light and moderate stocking reduce the amount of supplemental feed required to winter range cattle. Breeding cows on lightly and moderately stocked range required 2802 pounds and 2719 pounds less hay, respectively, than did the same number of cows on heavily stocked range.

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Supplemental feeding was not necessary until January 7, 1953 due to unusually mild weather. Cattle in all three stocking intensities were fed daily 15 pounds per head until April 6, after which time the cattle on lightly and moderately stocked range required feeding only every other day until April 20. Cattle on heavily stocked range required daily feeding until April 30, and again required feed on May 11 due to snow.

The cattle were put on winter range October 30, at which time the average weight of cows on heavily stocked range was 1031 pounds; moderately stocked, 1060 pounds; and lightly stocked, 1105 pounds. At the end of the winter season, May 14, the average weight of cows on heavily stocked range was 904 pounds; moderately stocked, 913 pounds; and lightly stocked, 982 pounds. The cows on lightly and moderately stocked range maintained their heavier weights all winter and required several days less feeding than the cows on heavily stocked range.

Cattle do well on mountain summer range. In spite of the unusually dry summer at high elevations in southwestern Montana, cattle on the Vigilante Experimental Range have fared very well this year. The following summary shows average weights of four classes of Hereford cattle on three dates during the current grazing season.

	June 12	July 15	August 7
	----(Average Wt. in Pounds)----		
Wet cows	775	901	1003
Calves	137	224	274
Yearling heifers	461	566	654
Two-year-old heifers	704	791	876

These data indicate average daily gains for the 56-day period of 2.4 pounds for calves, 3.4 pounds for yearling heifers, 3.1 pounds for two-year-old heifers, and 4.1 pounds for wet cows. Only the calves gained at a slower rate between July 15 and August 7 than they did between the start of the grazing season, June 12, and July 15. All other classes observed gained more rapidly during the second period. Failure of the calves to do so may be a reflection of the effect of drying forage on milk production by their dams.

How long such gains can be expected to continue depends directly upon the drying and curing of range forage which are in turn affected by weather. These factors have a direct bearing upon the advantageous marketing of cattle from these ranges. Dry and cull cows as well as other marketable cattle should be sold before any appreciable amount of these good summer gains have been lost due to continued hot weather and drying range forage.

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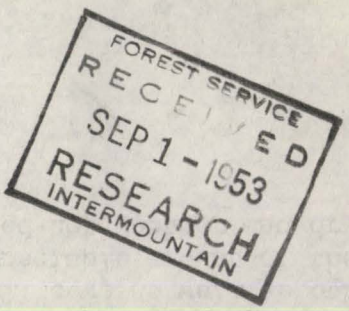

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NORTHERN ROCKY MOUNTAIN FOREST
AND RANGE EXPERIMENT STATION
MISSOULA, MONTANA

February 20, 1953

Growth and seed production of goatweed plants are influenced by the position of those plants in the stand. Ecological studies of goatweed conducted in the Inland Empire area have shown that peripheral plants grow taller and produce more seed than do plants growing in the center of dense patches.

Item observed	Kettle Falls area		Spokane area	
	Peripheral plants	Central plants	Peripheral plants	Central plants
Mature plant height (inches)			15.5	13.6
Percent plants flowering			100	82
Height fall regrowth (inches)			1.4	0.4
Percent plants showing fall regrowth			100	56
Seed stalks per plant	10	2	10	4
Seed capsules per stalk	98	37	99	28
Seeds per capsule	72	73	56	38
Seeds per plant	75,503	5,841	54,005	4,979

Peripheral plants were found to be superior to those growing in the center of the stand except in the case of seeds per capsule produced at the Kettle Falls study area. The observed differences are believed

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to have resulted from competition for soil nutrients and moisture between goatweed plants. Plants occurring in the center of the stand, "pioneers," first gain a foothold on depleted or disturbed areas. These plants develop and spread aggressively. In a few years the invaders almost completely eliminate other vegetation, and the goatweed colony spreads outward. The pioneers eventually dominate the area so completely that individual goatweed plants making up the stand compete with each other for soil moisture. Since a given soil under prevailing weather conditions is capable of maintaining only a certain amount of vegetation, a general reduction in thrift and density of these older plants results. On the other hand, peripheral plants get some additional soil nutrients and moisture from adjacent lightly vegetated areas. As a result, these peripheral plants are usually very vigorous and produce abundant foliage and seed, thus setting the stage for further expansion. Goatweed plants possess root systems superior to those of most native species, and the dense goatweed foliage decreases the amount of light available to the remnant native vegetation. The combined effects reduce the density of the native species and provide additional space for goatweed seedlings. Usually where goatweed is on the increase the range is in such poor condition that this undesirable plant has a relatively easy time of taking over.

Spring seeding in a clean well-packed seedbed produced successful stands of four forage grasses at Bremner's ranch. In a cooperative reseeding test on the "Dutch" Bremner ranch near Republic, Washington, four six-acre pastures were drilled, each to one of four grass species that have shown excellent adaptability in local nursery trials. Planting in a well-prepared seedbed that was packed before and after drilling gave successful stands of standard crested, intermediate, and pubescent wheatgrasses and Manchar smooth bromegrass.

The pastures are located on a plowed-abandoned bench having a well drained, gravelly loam soil that is low in humus and has a poor water-holding capacity. Before abandonment the area produced only 8 to 10 bushels of rye and was considered marginal for grain production. Cheatgrass, threadleaf Phacelia, Russian thistle, and knotweed occupied the area before the grass plantings were made.

In the spring of 1954 the plantings will be grazed by cattle to determine species response to grazing treatment. Spring gains of cows and calves grazing on these species and on cheatgrass will largely determine the grazing value of the reseeded species.

Despite unfavorable weather conditions throughout most of last year's growing season, goatweed beetles released in the spring of 1951 at four locations on the Colville National Forest promise to become successfully established. Periodic examinations have indicated that the beetles held their own or increased in numbers. Adult beetles were first observed in 1952 early in June and had reached "peak" numbers

toward the end of the month. High temperatures and low precipitation during July resulted in the early drying of goatweed leafage and caused the beetles to enter their dormant period earlier than usual. By mid-August a few active beetles were noted at only one location where goatweed foliage had remained green with more favorable growing conditions.

An abnormally long, dry fall season resulted in limited goatweed regrowth. Since this growth is dependent on the occurrence of fall rains and both are directly associated with termination of the beetles' summer dormant period, beetle emergence was retarded until late October. Even then, only very low beetle activity was noted. However, eggs were found when the areas were examined later indicating that beetle activity had increased.

Beetle larvae feed extensively during the late winter-early spring period on the goatweed growth produced the previous fall. It is this feeding that is damaging to the goatweed plant. The meager growth produced last fall has been supplemented by additional growth during the current winter, and present conditions indicate that beetle larvae will not want for food during the next few months.

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

June 29, 1953

Looking for goatweed beetles? Contrary to many prophecies and opinions the prolonged summer-fall drought in Montana last year did not obliterate the goatweed beetles. Prospects for the 1953 crop are good and in some locations the beetles are abundant -- that is, if you know what to look for.

Too often beetle release sites are searched, regardless of time of year, with the expectation of finding adult beetles present. If they aren't found the colony may be declared a failure and interest in biological control of goatweed abandoned. The life history of the goatweed beetle is just a little complicated, however, and we should be more realistic in sizing-up various situations. There are seven recognizable stages of beetle development, all closely geared to weather and plant growth. Let's learn them.

The first important stage, easily recognizable in the field, is the egg. Laid in the fall or spring, depending on weather, the egg is found above ground on leaves or stems of goatweed, or occasionally on other vegetation. It is cylindrical, one-half to one millimeter long, and yellow or orange in color. A mucilaginous secretion glues it to the vegetation, usually the underside of leaves, until hatching occurs.

The first stage larva is about the size of the egg, greyish brown in color and capable of only very slight motion. Very soon after hatching it climbs to the tip of a handy, green, goatweed leaf and starts feeding. In this stage the larva and its feeding are extremely hard to detect. Growth is very rapid with favorable weather and abundant goatweed growth, however, and the larva quickly changes to oval-oblong in shape.

The next three larval stages differ largely in size, color, and feeding habits. Feeding is done at night or during daytime periods of low illumination. Alternating resting periods are spent at the base of the plant in the shade or at a shallow level in the surface debris. Size increases to about 1/4-inch in length with a body diameter slightly larger than a wooden matchstick. In the second and third stages a greenish coloration appears on the back. In the advanced fourth stage this coloration spreads and acquires a yellowish tinge over the entire body. The black head is prominent, as are the six legs in all the later larval stages. A definite brown collar covers the upper surface of the first body segment behind the head.

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At maturity the larva burrows into the surface soil directly under the plants to a depth of one to two inches, forms a cell, and pupates. The pupa is easily recognized by its beetle-like contours and bright orange color. No feeding occurs in this stage.

Upon emergence the young beetle climbs the goatweed stems and starts feeding. This feeding further weakens the plants and often reduces or prevents flowering and seed production. Feeding continues until the beetle reaches maturity and hot weather occurs. Aestivation follows and continues until cool temperatures and precipitation return in the fall. These conditions end the summer dormant period and the insects resume feeding. Mating then occurs, followed by egg-laying, the first step in the new cycle. During aestivation adult beetles are difficult to find in the surface litter and top layer of soil.

It is impossible to set up a time table on these various stages for any location because of the vagaries of Montana weather. Several or none of the characteristic stages may be found on a single site at a given date. A series of liberation sites recently examined on the same date within a 100-mile radius of Missoula exhibited every developmental stage from the egg to the young beetle. The best guide to the determination of collectible populations and possible collection dates for any site is simply to make weekly observations in spring, beginning in early or mid-May. If establishment of a liberated colony is of interest the observations should be repeated in the fall after rains occur.

The first rule of collection procedure is to abandon fear of depleting a colony. More colonies have been lost for re-distribution purposes before anyone realized they could withstand collection than have been depleted by too heavy collecting. Some colonies will produce beetles for redistribution in one year after liberation -- others may remain at a low population level for three or more years.

The tools for collection are simply a bucket or cardboard box and a tight container for transportation purposes. Shake the beetles from the plants into the box, pour them into the container along with a few green stems of goatweed, and the job is done. An inch of beetles in a pint or quart ice-cream container is enough for a new colony. Goatweed stems in the container prevent compaction of the beetles and therefore make for higher survival. You will find more beetles up on the plants in early morning and late evening. Collection is therefore more fruitful at those times. To release a new colony, simply open the container and place it on the ground. Select a cool time of day for liberation, otherwise they may fly to a cooler site eventually less favorable for establishment.

United States Department of Agriculture
Forest Service
Northern Rocky Mountain Forest
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Missoula, Montana

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

January 14, 1952

Prepared in the Division of Range Research

Goatweed Beetles Thrive In The Northern Rockies: In May of this year 50-odd colonies of goatweed beetles, Chrysolina gemellata, were imported from California and released in western Montana as part of a broad cooperative program to control existing stands of goatweed on western Montana range lands and to prevent the spread of this undesirable plant to other areas. This phase of the program was financed with public funds through the Montana Office of Entomology and was conducted by that office in cooperation with the Western Montana Committee on Weed Control and several federal and state agencies. Recent observations have indicated that many of the beetles survived the summer and fall seasons and completed vital phases in their life cycle.

Of ten release sites observed in Sanders County on September 25, three showed some evidence of beetle feeding and at three others live, active beetles were found. On October 9 these as well as other 1951 release sites in Sanders County were well occupied by active beetles. Goatweed began fall growth on most Sanders County sites by late September and reached a height of two to three inches before low temperatures and snow occurred.

On two sites south of Grangeville, Idaho, where colonies of Chrysolina gemellata were released in May this year, evidence of considerable beetle feeding and rather large numbers of eggs were found in early November. Fall growth of goatweed on these sites was up to an inch in height when the observations were made.

These observations are encouraging. Success of the beetles in controlling existing stands of goatweed in the northern Rockies depends upon the occurrence of fall rains and late season growing weather. The fall rains cause the goatweed plants to resume growth and end the summer dormancy of the beetles. The beetles emerge from the surface litter, eat their fill of succulent new goatweed, mate, lay their eggs, and die. Thus the stage is set for another and ever increasing brood of beetles - the only practical answer to needed control of extensive infestations of goatweed now known on western range lands. Such control plus conservative grazing and good range management on uninfested ranges will prevent further spread of this noxious species.

Even more encouraging is the apparent success of a few colonies of another species, Chrysolina hyperici, introduced before the 1951 program was planned. Released in 1948 near Spokane, Washington, a colony of C. hyperici appeared to be quiescent until this year. On July 11, 1951, this release site was examined and large numbers of beetles were found at distances up to 1,100 feet from the release point. An area of one acre at the release point was completely devoid of goatweed. This species, C. hyperici, is known to have more difficulty in adjusting to a new environment and to be slower in reacting to fall weather conditions than the hardier C. gemellata.

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Three other colonies of C. hyperici, released in Sanders County in May 1949 became noticeable by virtue of their activity and effect on the goatweed for the first time this year. In early October live beetles were found at all of these locations for a distance of 200 feet around the release point.

Other colonies of both species, released at various locations in western Montana have been reported as active and doing well but detailed information concerning these is not now available.

Use of Granulated and Block Salt By Range Cattle: Granulated and block salt are two common forms of stock salt used on national forest summer ranges in southwestern Montana. However, there is little information available regarding comparative use of the two types of salt by range cattle. Several years of records from the Vigilante Experimental Range provide a comparison of the use of block and granulated salt.

Last year, for the first time in many years, white block salt was used, instead of granulated. Also, for the first time, the pasture was stocked with a mixed herd including cows and calves, two-year-olds, and yearlings. These cattle used 5.14 pounds of block salt per animal during the five-month grazing season. This is only 50.5 percent of the amount consumed in 1950 when granulated salt was available to a uniform herd of cows with calves. The ten-year average annual consumption since 1941 by range cattle on the pasture was 8.62 pounds per animal or 1-2/3 times as much as that used in 1951.

Although amount and kind of forage present, weather conditions, and big game use affect the amount of salt consumed, herd composition and type of salt are probably the main reasons for the lower salt use in 1951 as compared with previous years. As pointed out above, the 1951 herd was of mixed age classes while previous herds were composed of cows with calves. The younger animals consume less salt than do mature ones, thus lowering average salt consumption. Losses due to weathering and waste vary with the type of salt and are normally less when block salt is used. Also, cattle may show an abnormal liking for granulated salt simply because it is easy to eat. A "bossy" or "cranky" cow is more apt to dominate a salt block than a trough, not eating the salt herself but keeping other livestock away and thus reducing use on the block.

Although lower in total amount consumed during the season, the pattern of salt use in 1951 was the same as for previous years. As shown in the table below, the least amount of salt was used in June and the most in August with use tapering down in September and October. Use in each month was lower than in the corresponding month of previous years.

Average amount of salt, in pounds per animal, used by cattle on the Vigilante Experimental Range

Year	Month					Total
	June	July	August	September	October	
1948	.99	1.55	3.66	1.48	1.93	9.61
1949	1.36	2.16	2.50	1.80	-1/	7.82
1950	1.84	2.04	2.30	2.30	1.70	10.17
Average for three years 2/	1.40	1.92	2.82	1.86	1.82	9.20
1951 3/	.44	.52	1.69	1.30	1.19	5.14

1/ No salt used as cattle were removed from pasture end of September.
2/ Based on a uniform herd of cows and calves fed granulated stock salt.
3/ Based on a mixed herd fed white block salt.

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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

February 1952

Freshly burned "dog-hair" lodgepole pine stands may be successfully revegetated with several forage species. Tests were conducted in stagnated stands of lodgepole pine, which developed on the 1929 Dollar Mountain burn near Republic, Washington, to discover forage species that would grow on typical sites and to determine the feasibility of broadcasting the seed directly into fresh ashes. Such information is essential for this high fire hazard area where immediate revegetation for watershed protection would be necessary following any recurrence of accidental fire. Trees on two areas located on northeast- and southwest-facing slopes were slashed and the resulting debris was broadcast burned. Eighteen forage species were broadcast planted in the fresh ashes on individual plots of each area. The soils of both areas are of granitic origin. However, weathering of the parent material on the northeast slope is more advanced and the amount of topsoil somewhat greater than on the area with a southwest exposure.

After two growing seasons, several species appear to be well adapted to growing conditions on these sites. Based on plant vigor and stand density, the species appearing in the following summary produced satisfactory stands on one or both areas:

Average stand density, ungrazed leaf height, and vigor class of the most successful forage species on each study area

Species	Northeast exposure			Southwest exposure		
	Plants per sq.ft.	Leaf height (inches)	Vigor	Plants per sq.ft.	Leaf height (inches)	Vigor
Sheep fescue, common	19	5	Ex.	32	4	Good
Big bluegrass	18	9	Ex.	15	8	Good
Timothy	48	3	Good	33	2	Fair
Red top	12	4	Good	25	4	Fair
Orchardgrass, common	11	7	Good	13	4	Fair
Tall oatgrass, Tualatin	8	15	Good	7	9	Good
Alsike clover	13	1	Poor	12	¼*	Good

* Grazed height -- no ungrazed plants found.

Prepared in the Division of Range Research

Generally, the reseeded species were more successful on the area with the northeast exposure, probably because of more favorable moisture conditions. On this area the plants were thriftier and in most cases the stand density greater than on the southwest slope. Common sheep fescue and big bluegrass produced excellent stands on the northeast area; and timothy, red top, orchardgrass, and tall oatgrass produced satisfactory stands on both areas. Alsike clover appeared to be more adaptable to the site exposed to the southwest. Poor stands on both areas were obtained with standard crested, beardless, and stiff-hair wheatgrasses; Manchar smooth brome; tall fescue; green needlegrass; small burnet; Ladak alfalfa; and yellow sweet clover. Intermediate wheatgrass and Russian wild-rye failed completely on the southwest-facing area.

Use by deer and rabbits was more prevalent and included more of the reseeded species on the southwest than on the northeast slope. Alsike clover was the only species used on both areas; and of all the species grazed, it received the heaviest use. In addition, on the southwest-facing area smooth bromegrass, orchardgrass, tall fescue, and red top were grazed by these animals. The apparent species preference of wildlife, as shown on these areas, may be an important consideration in selecting species to reseed such areas that have been accidentally burned.

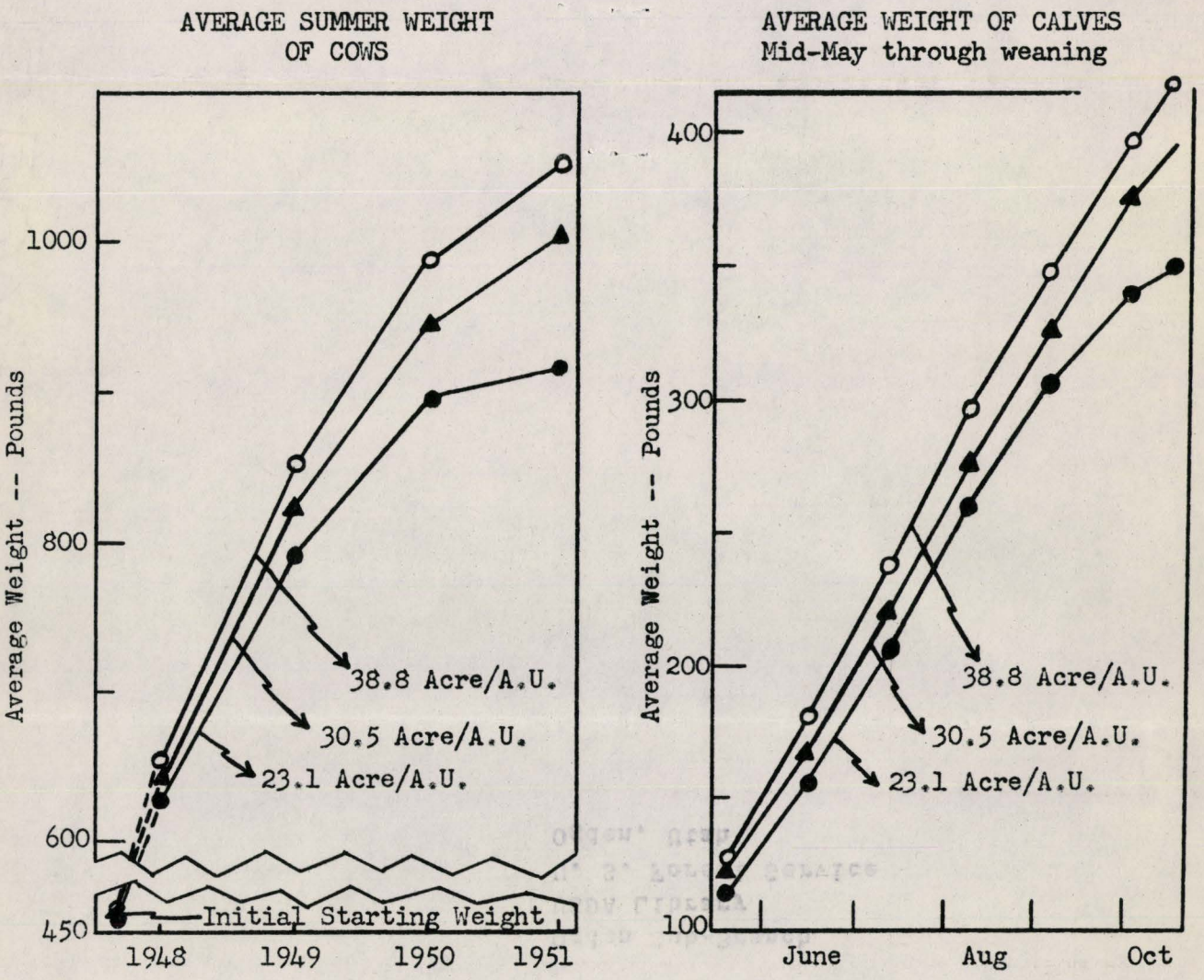
Several forage grasses appear to be well adapted to growing conditions in northeast Washington. Species adaptation tests have been conducted on well-drained sandy-loam soils near Republic since 1948. Spring and fall plantings of about 25 species, strains, and varieties of forage plants were made under similar conditions on the same site in each of 3 years. Periodic ratings of plant vigor and distribution in the stand of the reseeded species were made throughout each growing season. Based on these ratings, spring-planted species that produced excellent stands in each of 3 years were standard and Fairway crested, intermediate, tall, Whitmar beardless, Primar slender, and stiffhair wheatgrasses; tall fescue; Manchar smooth, common, and Bromar mountain bromegrasses; and Aberystwyth orchardgrass. These species also produced good stands when planted in the fall but were somewhat less successful than the spring plantings.

Producing less satisfactory stands and less herbage were bluestem, Siberian, and common slender wheatgrasses; common orchardgrass; sheep fescue; big bluegrass; and Ladak alfalfa. These species were about equally successful in both the spring and fall plantings. A group of species producing unsatisfactory stands of plants in poor vigor in both spring and fall plantings included timothy, Canada and Kentucky bluegrasses, burnet, an improved strain of needleandthread grass, and Ladak and creeping alfalfa. Failing completely in the fall plantings and producing very poor stands when planted in the spring were the superior strain of Reed canary grass, Russian wild-rye, perennial ryegrass, strawberry clover, Ladino white clover, and big trefoil.

The most outstanding species from these tests are to be used in field plantings and grazing trials in the mountainous areas of northeastern Washington.

Cattle weights reflect stocking intensity. Growth of range breeding cows and their spring calves, during 1950 and 1951, clearly reflected the rates of range stocking which the Miles City experimental pastures have been subjected to for more than 15 years. The experimental ranges were stocked in May 1948 with yearling heifers at the established rates of 23.1, 30.5, and 38.8 surface acres per animal unit yearlong. These stocking rates had been in effect

since 1933. The yearling heifers have grown to maturity and produced two crops of calves. Comparative growth of both cows and calves under the three stocking rates, illustrated by the following figure, strongly supports the concept that body size of animals is largely an expression of dietary level. In other words, the growth, as reflected by weight, of cows and calves in this study was correlated with abundance of forage in the pastures stocked at different levels.



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U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

October 17, 1952

Cleanings in young western white pine stands are effective. Protection of young western white pine from blister rust disease is not sufficient to assure adequate white pine yields on tracts where white pine is hard pressed by competitors. Cleanings are frequently needed in such stands to maintain sufficient white pine to justify investments for blister rust control. This point is demonstrated by a set of cleaning plots established in 1935 in the Upper West Branch of the Kaniksu National Forest. The plots test the release of white pine from competing western larch and other species. At the time the plots were established, the stand of dense reproduction which originated on a 1926 burn was 8 years old. Total number of trees averaged 13,000 per acre of which 5 percent were white pine and 45 percent were western larch. Both a moderate and a heavy cleaning were tested and a third plot was established to record development without cleaning. The following tabulation shows the composition of the dominant stand and the average height of all trees of the major species 15 years after cleaning.

Species	Composition of dominant stand			Average height of all trees		
	No cleaning	Moderate cleaning	Heavy cleaning	No cleaning	Moderate cleaning	Heavy cleaning
	Percent	Percent	Percent	Feet	Feet	Feet
Western white pine	1	24	43	6.2	13.8	19.9
Western larch	77	57	29	19.8	18.4	18.2
Lodgepole pine	17	1	8	24.7	20.3	19.9
Western redcedar	1	4	13	2.7	3.6	4.9
Other species	4	14	7			
All species	100	100	100			

It is evident that cleaning was effective in placing white pine in a dominant position and in providing for a favorable height growth. This test and others have shown that cleanings in white pine stands should be delayed until dominance is well established, usually at a stand age of about 10 years, at which time the cleaning should be heavy. A follow-up cleaning in 3 to 5 years after the first cleaning is desirable to maintain the lead of western white pine.

Prepared in the Division of Forest Management Research

Squirrels take 75 percent of the 1951 ponderosa pine seed crop. Preliminary results of a study of squirrel damage to ponderosa pine seed crops revealed that squirrels can reduce the size of seed crops materially. In early August, 1952, cone-bearing branches on 16 trees on study areas within the Kootenai National Forest were examined by climbing the trees. The examination showed that about 75 percent of the 1951 cones were taken by squirrels. Observations also revealed that in the process of removing the mature cones the squirrels inadvertently destroyed some of the conelets which would have matured the next season if they had been left on the trees. On the samples examined the squirrels usually removed the mature cones by cutting the cone-bearing shoots, thus destroying any immature cones which those shoots had, and thereby reducing the potential for the next crop.

These are preliminary data, necessarily based upon an estimate of past damage. Future observations including pre- and post-damage counts of cones on tagged branches will provide more reliable data.

Cost of piling slash and seedbed scarification with bulldozer increases as slope increases. The cost more than doubles when the slope percent increases from 10 to 40 percent. The following table shows the relative cost by average slope percent. The data are based upon six $2\frac{1}{2}$-acre plots in partially cut larch--Douglas-fir stands on Blue Mountain, Kootenai National Forest.

Average slope percent	Bulldozer 1/ time	Cost per acre	Relative cost
	Minutes	Dollars	Percent
10	52	12.97	100
20	71	17.74	137
30	90	22.52	174
40	109	27.30	210

1/ D-8 caterpillar tractor with Isaacson brush blade

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NORTHERN ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

MISSOULA, MONTANA

March 5, 1952

Wind and snow losses in mature western white pine greatest among poor vigor trees. Wind and snow have caused abnormal losses in forest stands of the northern Rocky Mountains during the last five years. Results from sample plots show that these losses in mature western white pine were more severe among trees rated as poor or fair in vigor than in trees classed as good or excellent in vigor. These results come from seven sample plots containing 56 acres with 3,656 tagged white pine trees. Four of these sample plots are located in a 180-year-old stand in the Deception Creek drainage, Coeur d'Alene National Forest, and three are in a 120-year-old stand in the Rapid Lightning Creek drainage, Kaniksu National Forest. Vigor of each tagged white pine tree was rated when the plots were established in 1941.

Records for the 10-year period 1941-51 show that 72 percent of the total white pine mortality on the plots was caused by wind and snow. Percentage losses of the 1941 board-foot volumes in each of four vigor classes from wind and snow were as follows:

Vigor Class	Percentage Loss
Excellent	4.2
Good	5.7
Fair	9.2
Poor	20.9

These results indicate that partial cuttings designed to remove poor vigor trees should aid in preventing losses from wind and snow.

Results of a selective cutting in lodgepole pine. In 1926, when Ranger William W. Larsen was supervising a lodgepole pine tie sale on the West Yellowstone District, Gallatin National Forest, he established a one-half-acre plot and measured the residual trees left after marking and logging for ties. At five-year intervals, members of the staff of the Gallatin have remeasured the trees. The results after 25 years indicate that the residual trees did not react favorably. At the time of logging, the residual trees were about 170 years of age, and their diameters ranged from 7.0 to 12.3 inches. Only 16 of the original 42 trees remain alive and the average increase in diameter of the survivors has been only 0.9 inch. In reporting the 1951 remeasurement, Frank B. Casler stated, "It is the prediction of the

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ter that not more than two or three of the trees will be alive 15 years hence. . . . . The volume of the live pulpwood now on the plot is about 48 percent of the volume on the plot when it was established."

Life expectancy of broken-topped western white pine trees. The increasing occurrence of blister rust infection in large pole and young mature stands of western white pine in the Inland Empire raises the question of how long trees with tops killed by infection will remain alive. The answer to this question is important in planning cutting schedules and in marking timber for salvage cuttings. To get an approximate answer to this question, permanent sample plot records were examined and nearly 600 trees with tops broken out by wind or snow were singled out and tabulated by crown class and the number of years of life after breakage. The tally showed that dominant and codominant white pine trees can sustain considerable breakage of the top, yet remain alive for a number of years. However, when a large percentage of the crown is removed from these crown classes, or when intermediate and suppressed trees lose their tops, death is likely to occur soon. The following estimate of life expectancy was prepared, based on the tabulation:

Crown Class	Percent of Live Crown Removed	Estimated Number of Years Life Expectancy
Dominant	1 - 50	15+
	51 - 75	10+
	75+	5+
Codominant	1 - 33	15+
	34 - 66	10+
	66+	5
Intermediate	1 - 50	5+
	51+	2
Suppressed	Any amount	0

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